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REMARKS

UPON THE *Newtonian Philosophy,*

As propos'd by

Sir ISAAC NEWTON, in his *Principia Philosophiæ*, &c. and by Dr. GREGORY, in his *Principia Astronomiæ Physicæ*.

WHEREIN

The Fallacies of the pretended Mathematical Demonstrations, by which those Authors support that Philosophy, are clearly laid open; and the Philosophy it self fully proved to be false and absurd, both by Mathematical and Physical Demonstration.

THE SECOND EDITION.

To which is prefix'd a *Preface*, shewing how a Set of Men, whose Characters and Interests depend upon the Reputation of that Philosophy, endeavour to support it in the Eyes of the World against these *Remarks*, by indirect Management, for Want of Reason and Argument.

By GEORGE GORDON.

*Faciunt hi plura: sed illos
Defendit numerus, junctæque umbone phalanges.*
Juvén.

L O N D O N:

Printed for J. PEELE, at Locke's-Head; between the Two Temple-Gates in Fleet-Street.





T H E P R E F A C E.



*W*HEN I wrote these Remarks upon the System of the World, as it is modelled by Sir Isaac Newton, (which is what we call the Newtonian-Philosophy,) I imagin'd that the Part of Nature, of which I had chosen to write, was a Subject wherein Mens Passions and Interests were no ways engaged. I knew there was no Party that accused the Sun of Tyranny, for scorching a great Part of our Globe with intolerable Heat, and leaving another Part almost destitute of his Influence; nor any Faction that proposed to raise it self by rebelling against that glorious Monarch of the World. I knew there was no Set of Men that had a Plot of pulling down Saturn from his Orbit, for his Malevolent Aspects; nor of advancing Jupiter to a higher Station in Nature, for his friendly Influences. I knew that

no Sort of Persons were disaffected to the Government of the Sovereign Natural Cause, which at present rules the Motions of the beautiful System of the World. In fine, I knew that no Part of the Universe was in fear of a Rival, nor stood in Need of a Party to defend it in the Exercise of its Office, or gave to its Adherents such Rewards as do engage Mens Passions and Interests, and make Parties in the World: And from thence concluded, that Mens Passions and Interests were no ways concerned in these Affairs. That in these Matters, Men wanted no more but to know what was Truth, and what was Error; and that being unbiassed, nothing would be needful for perswading them what was so, but clear Evidence, and sound Arguments only.

Having this View of what I had undertaken, I was at no Pains to guard my Reader against those Arts by which Parties practise upon Mens Credulity. I did not court my Reader for gaining his Favour, nor so much as make him the common Complement of a Preface; neither did I use any of those Arts by which Authors make a Handle of Mens Passions to perswade them, but apply'd myself to the Understanding only. I imagin'd also that *αὐτός ἐστιν* was a Maxim in Philosophy now antiquated, and that this discerning Age would not (at least in this Part of Physicks,) be so blind, as to make Authority the Touch-Stone of Truth, which had all along recommended gross Errors instead of it. And this it was that made me not afraid to oppose clear Evidence, and sound Argument, (in that Affair) to the Authority of Men of the greatest Name, nor endeavour to get any Authority to back my Arguments. I did not join
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my self to any Party, that their Countenance might support me in my Undertaking; nay, I did not so much as seek for the Approbation of any one Man of great Name, thereby to recommend my Performance to the World; neither did I study to support what I advanced by any of those Methods which are proper to be taken in all Cases where Authority is look'd for, or where Human Passions and Interests are concerned. My only care was to advance nothing but Truth, and to support it by such Arguments as should be able to stand against the most powerful Objections. And if (as I imagined) Mens Interests and Passions had not been concerned in my Subject, nor themselves guided by Authority, and that they had wanted no more than to have Truth shew'd them, it had certainly been most proper to shew it (as I did) dress'd with nothing but clear Evidence and sound Arguments; because these are the only Ornaments that make it shine in its full Lustre. And certainly unbiass'd Persons must have known it better, and embrac'd it more readily, when appearing in that plain and artless Condition, than if it had been recommended to them by pathetick Speeches; supported by Numbers; joined by Parties; approved of by Men of great Name; or attended with any of the rest of that Kind of Retinue, which oftener accompany Falshood than Truth; and are in Reality, neither Marks of Truth nor Falshood. But as it has happen'd that I was mistaken, in thinking that Men were not guided in those Affairs by Authority, and that their Passions and Interests were not concerned in my Subject; so this Mistake has occasion'd my taking a very unfit Method of recommending my Opinions to the World, and

made me neglect the proper Means of Persuasion.

I might easily have known, that in such sublime and difficult Matters, few have Capacity and Courage enough to think for themselves, and that the Weakness of Human Understanding in the Generality of Mankind, does in these Matters as naturally lead them into a Submission of their Judgments to the Opinions of those who pretend to instruct them; as the Impotence of Human Nature, to support it self without Society and Government, leads Men into a Submission of their Civil Concerns, to such as have the Courage to assume a Superiority and Jurisdiction over them. All the Choice Men have in any of these Affairs, being (in Case of a Competition among those who dare be great either in the civil or learned World,) that they may choose to which of the Competitors they will submit. But in both these Affairs, the Bulk of Mankind are by an irreversible Decree of Nature obliged to submit: And therefore, they have not only done so in preceding Ages, and do so now, but must continue to do so while Human Nature continues the same: So that I was widely mistaken, in thinking that in those Matters of which I wrote, Men did not depend upon Authority now, as they did in former Ages; and that they are not now as liable to be led into gross Errors by that Ignis Fatuus, as their Fore-fathers.

It was a Mistake in me no less gross than the former, to believe that Mens Passions and Interests were not concerned in my Subject, since I might easily have known, that tho' the Parts of the Universe themselves could not stand in Need of a Party to keep them in their Offices; yet that these

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Opinions of Philosophers concerning those Parts; to which Men do at present submit, might want to be kept up in the Eyes of the World. I should have known also, that they who teach the World these Opinions, have in Return, receiv'd from the World Esteem, Wealth and Honour; such Rewards as are most agreeable to Human Nature: That the Continuance of these Advantages, in a great Measure depends upon supporting the Credit of those Opinions from which they arose: And consequently, that these Men are, by their Passions and Interests, as directly engaged to support their Sentiments in the Eyes of the World; as they who enjoy the beneficial Offices of the State, are to support that Government, in which they are engaged.

It is not only plain, that the Possession of high Stations in the Learned, as well as the Civil World, engage; but also, that they enable the Possessors to support that from whence so great Advantages arise to them. For eminent Places among those to whom we submit in the Affair of Learning, not only carry along with them great Advantages, as well as high Offices, among those to whom we submit in Civil Concerns; but also, the great Men who have the Administration of the Affairs of the Learned World, are capable in their Way, by Interest and Commendations, to reward their inferior Adherents, with an inferior Degree of those Blessings which themselves enjoy, and so engage their Passions and Interests in the Affair also; and thereby bind them to concur and assist in supporting the common Cause: As well as Statesmen can strengthen that Government of which they have the Administration, by putting whom they think
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most proper for that End, into the inferior Offices of the State. And Experience shews us, that in the Affair of Learning as well as Government, the implicit Crowd, who neither understand, nor have any Interest in the Matter, without having any other Motive but their being engag'd, and habituated to join in the Affair, are almost as strenuous and passionate in supporting the common Cause, as those whom Interest binds to it: And implicit Ignorance secures the former as much from being overcome by good Arguments, as Passion and Interest does the latter.

In short, it is evident, that whether in the Affair of Learning, in civil Concerns, or in any other Matter, suitable Encouragement breeds Parties; and where any Thing affords so considerable an Encouragement, as was that universal Applause, with which the Newtonian Philosophy was received in the World; there a Party to espouse the Cause, does as naturally and necessarily spring from such Encouragement, as Grass springs from a good Soil that affords it sufficient Nourishment. So that they who have listed themselves Followers and Admirers of Sir Isaac Newton and his Opinions, are a Party produc'd, and subsisting upon the same Motives as other Parties, and altogether of the same Nature with them; and their Conduct in supporting their Party, being the Effect of the same Cause, must also be the same as the Conduct of other Parties: And he knows but little of the Affairs of the Learned World, who knows not how considerable that Party is in it. For first, the Newtonian Philosophy is so mysterious, that all Mankind (a very few only excepted) are ignorant in that Point, and belong to
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that Class of Men, who are under a Necessity of submitting their Judgments; and there having been no considerable Opposition made to that Philosophy since its Publication by any Competitor, these Men have hitherto hardly had any Choice; but have been all obliged to embrace that Philosophy. Upon the other Hand, those very few, who understand that mysterious System, have not attained that Piece of Learning without a great deal of Study; nor is it to be supposed that Men would put themselves to so much Trouble as that Attainment requires, without a Prospect of being at least esteemed by the World for so uncommon a Piece of Learning; or even if a meer Inclination to Study should have supported some under the Fatigue of studying over Newton's Principia, yet who is so self-deny'd as not to conceive a greater Opinion of himself, and endeavour to appear something more in the Eyes of the World, when he finds himself Master of so rare a Piece of Knowledge, which alone is sufficient to intitle him to the Character of a Man of bright Parts and deep Learning? In short, it's plain, that by far the greater Part of those who understand that Philosophy, both value themselves, and are valued by the World, upon that Account; and are by their Passions and Interests consequently engaged in the Party. And at this Rate, how considerable, and how powerful this Party is, I think sufficiently appears.

But as plain and evident as all this appears to me now, yet I reflected not upon it, before Publishing these Remarks, when it was the proper Time to have done so; and never found it out, till I saw myself attack'd by a strong Party in the
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most injurious Manner; and then Experience, the Schoolmaster of Fools, taught me to understand whom I had offended. I imagin'd when I publish'd these Remarks, that I had nothing to fear but the Objections that might be made against my Arguments, and the Faults that might be found in my Reasonings; but to my Surprize, I found that neither Objection nor Reason was used against me; but the Party whom I had offended, sensible of their own great Strength, and of my Weakness; of the great Credit and Authority they had got in the World, and of my being destitute of either, contented themselves (instead of objecting) with telling the World that I and my Arguments were silly, and not worth their Notice; and by the Strength of their Credit and Authority together, with the most unjust and injurious Management, have got the World to depend upon their Character of my Remarks, and prevailed with them not to examine the Matter, but to take all from them upon Trust.

If I believed that Men had submitted themselves to Sir Isaac Newton in Philosophy with this View, not to put themselves any more to the Trouble of using their Reason in that Affair, or of being solicitous what was Truth and what was Error, and resolv'd henceforth to take that for Truth which he affirm'd to be so, whether it were true or false; if I believ'd, I say, that the World had in this Manner submitted to Sir Isaac, the Respect due to Mankind from every Individual, would oblige me also to own him for my lawful Governour, whom all Mankind had chose for theirs. But I well know that those who are most strenuous in his Behalf, (a very few only excepted) are so, neither for
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their own Interest, nor out of any particular Regard to his Person, but because they believe his Opinions to be true, and his Arguments to be good; whereas if those Men knew how much they are abused by them who have made them believe so, they would act a quite different Part: And therefore it is neither opposing those Men, nor any Disrespect to so considerable a Part of Mankind: For one, who sees how much they are abused by designing Men, to endeavour to disabuse them, which was the Design of these Remarks, wherein I have shewed them, if they would allow themselves to see, that the Philosophy which they are so much taken up with, is grossly absurd; and the Arguments that support it, meer Sophistry. And the Design of this Preface is to shew how those same Men continue to abuse them, and hinder them from looking at Truth, when clearly proposed to them; and how they injure me in making the World believe that my Arguments are silly, because they cannot answer them. And the Conduct of that Party, in opposing my Remarks, is such, that I am convinc'd the bare Narration of it (which is what I have further to say at this Time,) will make the Truth appear.

Some Time before Publishing of these Remarks, a Friend of mine wrote to his Correspondent at Oxford, that such a Book was to be published, that some were to be sent to Oxford, and that he desired of him to engage some Booksellers to sell them there. My Friend received Answer, that such a Book would not take in that Place; but certainly be neglected. And I was so dull as to laugh at the Gentleman's Foresight, who pretended to know what Reception a Book would meet with,
before

before he knew what Reception it would deserve; but the Event shewed him to be in the Right, and me to be the Person that deserved to be laugh'd at, for not having foreseen as he did, that its Reception depended upon the Strength of the Party who were engaged to oppose it; a Thing very different from what I imagined was to determine its Reception. For some Time after Publication, the same Gentleman wrote, that as he foresaw, so it happened; for though the Book had been exposed to Sale for some considerable Time, in the most noted Booksellers Shops in Oxford, there had not so much as One been sold, and that every Body there believ'd it to be silly and not worth reading.

It appears from this Story, that every Body condemned, and none would read the Book; and condemning a Man unheard, I think will be easily allowed to be the highest Injustice. It will also appear from a very little Reflection upon the Uncommonness of the Nature of the Book, and from the Nature of the Place, that some would have been bought at first, tho' the Book had been ever so silly, if extraordinary Care had not been taken to perswade every Body timeously that it was silly: Nay, any Man that will impartially reflect upon such an universal Abstinence from reading such a Book in such a Place, and at the same Time that the Men of Letters there are all in a Manner connected together, will easily see that which was really the Case; that some of the Leading Men in the University used their Interest with the whole Society, to hinder them from reading: For merely giving a bad Character of the Book would never have satisfy'd every one's Curiosity so fully, but
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that some one or other, would have had the Curiosity to read it. It appears also, that the Management which was necessary for effecting the Matter so as it happened at Oxford, is exactly opposite to real Neglect: And the Fate the Book had, of not being bought at all at first, and being bought afterwards, is also the Reverse of the Effect of Sil-
liness, in a Book that promises great Things: For Experience shews us, that when Men really despise a Book, they let it alone to take its Fate; and those whose Opinions it may contradict, are at no Pains to hinder Men from reading it; because like Patches which makes the Face seem whiter, such Performances do Service rather than Hurt to what they oppose; and contrary to the Fate of my Book at Oxford, such Books always sell at first, and not at all afterwards; but it's needless to insist upon these obvious Reflections; so that I shall proceed in my Narration.

Some Time after Publication, one Mr. Græme, a Friend of mine, who had read the Book, and understood the Subject perfectly well, happened to go to Edinburgh, where he found that it had the very same Fate and Character as at Oxford. And not only so, but that it was there loaded with a great many unjust ill-natur'd Calumnies; such as that the Name prefix'd to the Book, was not the Author's Name, but a borrow'd one, and the like. Mr. Græme declar'd himself openly for the Book in all Companies, and made it his Business to converse with the most noted Mathematicians in Town upon the Subject; but when he came to Particulars, he found that they had not read the Book. He entreated several to read and consider it, and after so doing, to point out its Faults to
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him;

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him; but could hear of no particular *Objections* that were made by any Man, nor prevail with any to point out its *Faults*; save only that one of those to whom he apply'd, shew'd him some written *Objections*, which it seems were handed about, and shew'd to proper Persons; but at the same Time exacted a Promise of him, that he should neither discover the *Objections*, nor his Name, or the Name of the Author of these *Objections*; so that I could not prevail with Mr. Græme to tell me any more of this Story, than in general that the *Objections* were very weak, and only fit for satisfying ignorant People: And that being the *Objections* of a Man of Reputation, if he had been at Freedom to discover the whole Matter, it would have been of great Use to me, in shewing to the World the Scarcity of Argument which those who oppose me labour under. He further told me, that tho' the Person who shew'd him the *Objections*, made him promise Secrecy; yet he is of Opinion, that he might have prevail'd with him to release him from that Promise, if he had not unluckily exposed to him the Weakness of the *Objections* in such a Manner, as to give him a full View of the Danger of allowing him to do so to others.

It is in vain for me to trouble the Reader with my Reflections upon this Fact, it being so plain that the Pretence of the Book's Silliness was inconsistent with the Conduct of those who pretended it; for if the Book had been silly, it would not have been so hard a Matter to prevail with some Body to point out its *Faults*; neither would those who endeavour'd to do so, have been so careful in concealing what they said upon the Head. In short, this Fact shows clearly the Weakness of my Opponents

nents in Argument, and their Strength in Credit and Authority; and that they dare make no manner of Use of the former, but must depend wholly upon the latter for the Defence of their Philosophy against these Remarks.

I come now to the Reception my Book had at London, which I can give a more full Account of, because I was there my self. Some small Time before publishing, one of the Booksellers whom I had employ'd, desir'd me to employ also a Friend of his, one Mr. Taylor, and bid me put his, together with the Names of the rest of the Booksellers, to whom the Title directs Buyers, which I did; and he at the same Time, sent Mr. Taylor Word what he had done; who returned Answer, that he would not for Five Pound have his Name in the Title of such a Book, and if it was put in, he would seek Redress of the Injury by Law; so that I was obliged to alter the Title and take out his Name. This extraordinary Manner that Mr. Taylor took to resent being employ'd in his Way of Business, was the first Thing that made me begin to foresee what Kind of Opposition I was like to meet with; but it was not then Time to think of using Means to prevent it.

The Day of its Publication, I made a Present of One to a Club of Mathematicians, who meet every Monday-Night under the Denomination of the Mathematical-Club; but one Mr. Foulks, who happen'd to be there at that Time, carry'd it away with him, and has kept it ever since, and would not return it, tho' the Club sent their Steward on purpose to get it back; so exact Care was there taken to hinder the Heresie from taking Root in that Company.

The Greatness of this Place however, made it impossible for them here, as at Oxford and Edinburgh, to hinder every Body from buying, tho' they were not wanting in their Endeavours that Way; but they fell upon something equivalent, which was to hinder the Booksellers from selling. How far they succeeded in this, and what Methods they used, I will not affirm farther than I have Evidence, tho' I have good Reason to suspect much more. One told me that when he called for the Book at Mr. Brown's Shop, his Shop-keeper was at a great deal of Pains to give a bad Character of it, which it's plain he would not have done of his own Accord, it being directly against his Interest to hinder the Sale of his Goods; and another who called for the Book at the same Shop, had for Answer, that they had None but what were in the Ware-House; which was false: For at that Time they were in the Shop. Another of the Booksellers also, acknowledg'd he was forbid to sell it. Now these Facts shew that there have been Endeavours used with some of the Booksellers, and I see no Reason to question the like of the rest; and it's very evident how powerful the Party who oppose me must be with the Booksellers, and how imprudent it must have been in them to disoblige so considerable Customers, for any small Matter they could expect from the Sale of my Book.

By this Time, I saw that the Management of those who opposed me, was to give the Book a bad Name, and hinder People from seeing it; lest they should be undeceived. To oppose which Management, I used all the Interest I could among my Acquaintance to get them to read the Book,
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and to desire their Acquaintance to do the like, which several did ; none of which found any Fault with it. I then further desired them, that in any Companies where they happened to be when it came in their Way, they would be so just as to declare their real Sentiments of the Book, which they promised to do ; but these my Endeavours were by far too weak to oppose the Party which I had to deal with : For some of those who had read the Book, and promised to declare their Sentiments of it, in a little Time afterwards told me, that the Report of the Book being extremely silly, and its Author being an ignorant enterprizing Fool, was so very strong, that by commending it, they were afraid to get such a Character themselves. Others told me, that they were ashamed to contradict so many as opposed them with so much Assurance. One told me, that he had in several Companies freely declar'd his Opinion of the Book ; but that he had been severely check'd for so doing by one of his best Friends, and forbid to do so any more, and that I must excuse him for complying. This Person's Name, together with his who forbid him to speak any more in the Behalf of my Book, I would gladly publish, because the Story is somewhat remarkable ; but that this were doing my Friend who told me the Story an Injury, and giving his Friend greater Ground to blame him.

One, of whom I expected that he would have exerted himself strenuously in my Behalf, who had a pretty general Acquaintance, told me that he had shew'd the Book to several who understood the Subject, and had no great Temptation to be partial : That he was fully satisfy'd by their concurring Sentiments as well as his own, that there was no Ob-

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jection of any *Value* to be made against me. But that he would take the *Liberty* to tell me what they also said, and what himself thought, which was, that I could not but know, that the most *Eminent Men* for their *Learning* in the *World* had not only approved of, but highly commended to the *World* the *Newtonian Philosophy*, as one of the greatest *Improvements* of *Learning*. That a great many of those *Mens Writings* by which they have made themselves famous, are either built upon this *Foundation*, or necessarily connected with it. And consequently, that telling the *World* (as I do) that this *Philosophy* is meer *Fiction* and *Aburdity*, and its *Arguments* no better than *Sophisms*, is attacking those *Men* in the tenderest *Point*, and in the most provoking *Manner*. That I could not expect less than that they would, in return, endeavour to vilify me and my *Performance*. That I was no ways provided for an *Engagement* with so powerful a *Party*. And tho' my *Arguments* were good; yet good *Arguments*, especially in a *Matter* so little underderstood, would not be sufficient to convince the *World* without any *Body* to back them, when every *Body* opposed them: And tho' clear *Truth* would in *Time* prevail, yet it was hard to say how long so strong a *Party* might be able to make it pass for *Falshood* in the *Eyes* of the *World*: perhaps longer than I should live. And if so, that by my *Undertaking* I had occasion'd myself to be made appear during *Life*, in the *Eyes* of the *World*, a silly enterprizing *Fool*; which is more inconvenient than to be and not appear such. That upon the *Whole*, I had acted a very imprudent *Part*. That he was too weak to help me; and that if he should endeavour it, he should only

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be able to hurt himself in the same manner as I had done; which were to act the same imprudent Part, for which he blamed me. He also told me, that such of my Acquaintance as understood not the Subject, believed the common Report; that such as understood it were of his Mind; and that though perhaps they were not so free as to tell me so, yet they would no more appear in my Behalf than he would.

This so very plain and close Reproof, gave me no small Uneasiness; it vexed me to think that my Acquaintances look'd upon me to be a Fool, and that none of them would assist me; nay, it vexed me much more when I reflected, that these Sentiments and that Conduct of theirs, was what I could not blame them for; and that the whole Blame lay upon my self, for not seeing what was so obvious. In short, I was upon Reflection, not only vexed, but surpriz'd at my own Dulness, and wondered how I came to imagine that a Set of Men, the most famous in the World for their Learning, would tamely suffer that with which their Reputation was necessarily connected, to be vilified in the Eyes of the World, by one who appear'd to be in no condition for making good such an Undertaking: How could I think that they would not hinder a thing so dear to them as their Reputation, from being thus impair'd, when they saw it in their Power to do so. Are human Passions become so weak, and Men so disinterested? or is it to be believed, that they will so freely part with what is most dear to them, for the sake of Truth only; nay, for the sake of such a Truth as very little concerns Human Affairs, when we see them every where maintaining Errors which are
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destructive of Mankind, rather than forgo their Passions and Interests? Or how could I believe, that the Party, whose Philosophy I impugn, would suffer their many Writings which are connected with that Philosophy, and must stand and fall with it, to be all overturned? Are Authors so easily induced to suffer their Writings (those Children, of the Understanding, which are as naturally dear to Men as the Fruit of their Body,) to be thus snatch'd away from them, when it is in their Power to hinder it? Or if perhaps I was not quite so stupid as to foresee no Opposition, and expect that these Men would at first yield the Cause; yet certainly I was so dull as to foresee no Method they would take of opposing me, but by Argument, which was almost as great Stupidity as if I had foreseen no Opposition at all. For what is more evident, than that the Effect of their using Arguments against me, was to make the World look into the Matter. And this was what I ought to have known they would be obliged to avoid; for I knew that the Absurdity of their Philosophy, and the Defects of those Arguments by which it was supported, had lain hitherto safe from Observation, only by being cover'd from View with Obscurity: That now, when I had drawn the Curtain of Obscurity, and shew'd them naked to the World, nothing would do but to hinder the World from looking; and that if they themselves by answering my Arguments, should have caused the World to look into the Matter; This had been doing my Work for me, and pulling down their great Diana with their own Hands, which it was unpardonable Dulness in me to expect from them. Besides, how could I imagine, that they who

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were conscious to themselves, of being so highly honour'd by the World's Esteem, would not take Care upon such an Occasion, to make use of that high Dignity, which in the Eyes of the World gave them a Title to despise what was said by one so much below their Quality; and excused them from stooping so low, as to reason Matters fairly with a Man of no Name; or from bringing themselves upon a Level with such a one, by using Arguments of which he might happen to be no worse provided than themselves. But above all, how could I think that they would endeavour to use Arguments, when I knew they had none worth using? Or how could I forget, that they had Number, Authority, Reputation and Interest, which are Means much fitter for supporting their Opinions in the Eyes of the World? How could I think that a Set of wise and learned Men would neglect to make use of those Weapons in their own Defence, of which they found themselves provided, or that they would endeavour to defend themselves with such Weapons as they knew they were altogether destitute of: when mere Instinct teaches the very brute Creatures this Discretion, as the Poet very elegantly expresses it.

Ut, quo quisque valet suspectos terreat, utque
Imperet hoc natura potens, sic collige. —
Dente Lupus, Cornu Taurus petit. Unde,
nisi intus
Monstratum? ————— Hor.

I might have attacked a Lion, upon Supposition that he would only push at me with Horns, and that he would make no use of his Claws or Teeth,

as reasonably as I did attack this Party upon the View of their using nothing but Arguments ; neither would the one Rashness have engaged me in a more unequal Combat than the other has done ; for the question betwixt them and me is, who shall convince the World that what they say is true, and they have not only Authority, Reputation, Interest and Number, very powerful Means, upon their side ; all which I am utterly destitute of : But what is more useful to them than all the rest, they themselves have the only Title to judge betwixt them and me. For all that I can do upon my part is, to bring Arguments to prove what I advance, and the Question being to convince the World, the Sufficiency of these Arguments must be judged of by such as the World esteems to be most capable to judge in that Affair : And all those who are esteemed by the World for their Capacity that way, are by that very Esteem engaged to oppose me, because they have all joined in with the Newtonian Philosophy, and highly commended it to the World, and must lose some share of that Esteem, if they cannot support the Credit of that Philosophy.

These and such like Reflections upon the unequal Combat in which I had engaged my self, gave me a very melancholy Prospect of the Event ; and when I reflected upon the gross Oversight which had brought me upon that Lock, I was almost quite out of Conceit with my self for my Dullness, which I found to be the greatest Uneasiness imaginable : For nothing is a more essential Ingredient in the Enjoyments of Life, than that good Opinion which every one naturally has of himself. Sometimes I endeavour'd to recover my own Esteem

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steem, by reflecting that it was my extreme Regard for Truth and sound Argument, which so intirely took up my Mind as to leave no Room for any Thing else; whereas if my Mind had not been so much taken up, I should have been as ready to see what was obvious as another Man. But still methought it was silly to be so much taken up with so unfashionable a Thing as Truth, and to neglect what much nearer concerned me; and that it look'd as Ridiculous, as to see a Fellow so intent upon gazing at the Stars while he walks along, as not to see a Stone that lies in his Way, till it break his Shins. I endeavour'd also to palliate my Error in my own Eyes, by bringing great Examples to justify it; as that Story of Archimedes, who was so much taken up with the Contrivance of a Machine for the Defence of a Besieged City where he was, that he did not see the Enemy who took the Town while he was at his Meditations, nor used any Means to provide for his Safety; but was catch'd napping at his Studies by the Soldiers, and kill'd. I brought also several Examples of that Nature from our great Man Sir Isaac Newton, who has often been observed to be so intent upon Contemplations of Things a little out of the common Road, as not to see what was obvious to every Body else: As the Story that is reported of him, that while he was walking the Streets in a deep Meditation, instead of Pissing against a Wall, he Piss'd in an Apple-Woman's Basket of Fruit, and never was sensible of his Mistake, till he was awak'd out of his Studies by the Clamour of the Woman resenting the Injury done her. Just so I never understood whom I was offending, till I was awak'd by their Re-
sentments;

sentments; so much my Mind was taken up with Things so far out of the common Road, as Truth and good Arguments. I could have brought a great many more Instances of this Kind, for justifying my Error by great Examples, but that would not satisfy me; for it appear'd to be but very small Satisfaction to resemble these great Men, in that wherein they were most unlike themselves.

Notwithstanding my Dissatisfaction with myself for having made such a rash Attempt, yet being engaged, I was under a Necessity of proceeding in it in the best Manner I could. And the Means I next thought of, was to desire of my Acquaintances, that tho' they would not take my Part, yet they would endeavour to get me Notice, what Reason they who gave a bad Character of my Book, would give for their so doing. In which Affair, they did exert themselves in my Behalf, as much as I could have expected. They told People, that tho' they did not question since it was every Body's Opinion, but the Book might be silly, yet they would gladly know what were its particular Defects: And for a pretty while after Publication, they could get no Satisfaction to that Question, but this; That it was certain that Dr. Halley (one whose Capacity for judging in such a Subject was not to be question'd,) had the Day after the Publication, and at several other Times, in several Publick Companies, given the Book the same Character as they did.

When I heard this, it did me the Favour to cure me perfectly of that bad Opinion which I had for some Time entertained of my self; for by this Story it appear'd, that the rest of the World were
as

as ready as I was to fall into gross Mistakes; and what gave me the fuller Satisfaction was, that I saw the *World's* Mistake and mine to be the very same; so that I found sufficient Shelter for my Error under the Excuse of Human-Frailty, and saw that I had no better Reason to undervalue my self for being obnoxious to those Weaknesses which all other Men are liable to, than for not having Limbs made of Brass: And indeed who ought to be dissatisfy'd with himself, or blam'd by others, for those Infirmities which are common to Mankind?

Now it appeared to me, that the rest of the *World* foresaw no Reason more than I did, for questioning but that the Book would meet with such Reception, and get such a Character from the Learned as it deserved. I before did not foresee that Kind of Opposition which it happened to meet with, and they now did not suspect it. In short, their Mistake and mine were in themselves every Way the same, and differed in Circumstances only; nay, I cannot say that my Mistake was quite so gross as their's: For tho' I was so far mistaken as to expect a just Sentiment of my Performance from the Generality of the Learned *World*, and did not see how generally they were engaged against me, nor what Methods they would take in opposing me; yet to do my self Justice, I never was so dull as to expect a just Sentiment of it from Dr. Halley. So that the *World* in this Point exceeded me in Inadvertence; and were I not so deeply engag'd my self in that Error, I should be ready to complain of the *World*, for not remembering that something beside Capacity is requisite to make a Man a good Judge; since

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Since it is universally known, that Disinterestedness and Integrity are much more wanted in those who assume that Office: And certainly the World could not have imagin'd the Doctor to be furnish'd with any of those Qualifications for judging of my Book, if they had reflect'd upon the Matter; and I should have thought it needless to suggest to them such an obvious Reflection, were it not that by their not having reflect'd upon it, they have demonstrated the Reflection not to be sufficiently obvious.

All I shall say to suggest the Reflection of the Doctor's Unfitness to judge of my Book is, to desire that the Reader will compare its Title with the Judgment which the Doctor has already publish'd of the Newtonian Philosophy, which is this:

‘ That HE to whom we are indebted for the
‘ Newtonian Philosophy, has done Mankind a
‘ greater Service, and afforded them more Remedies
‘ against the Inconveniencies of Life, than
‘ they who formed Men into Societies, and guard-
‘ ed those Societies from foreign Violence by Fortifications, or from intestine Irregularities by
‘ Laws. Than they who bless'd Mankind by discovering the Use of Corn and Wine. Or than
‘ they who instructed the World in Letters, and
‘ laid the Foundations of Learning.’ And those I think are Mankind's greatest Benefactors, who have done them the most valuable Services, and afforded them the best Remedies against the Inconveniencies of Life; which the Doctor represents as very few, when compared with those that arise to us from the Newtonian Philosophy. But I shall give his Judgment in his own Words,
for

for they are much Loftier, and more Emphaticall than mine; and it is but mincing this Noble Sentiment of the Doctor's, to exprefs it in any Words but his own, which I fhould not have prefumed to do, but for the Benefit of thofe who underftand not the Language in which he wrote. Having enumerated the many and great Advantages that arife to us from the Newtonian Philofophy, he compares them with the Advantages of fuch Services as have been done to Mankind by others, in thefe Words.

Qui fcriptis primus tabulis compescere Cædes;
Furta & adulteria, & perjuræ Crimina fraudis;
Quive vagis populis Circundari mænibus urbes
Author erat; Cererifve beavit munere gentes;
Vel qui Curarum Lenimen preffit ab Uva;
Vel qui Niliaca monstravit arundine pictos
Confociare fonos, oculisque exponere voces;
Humanam Sortem minus extulit; UT PO-
TE PAUCA
IN COMMUNE FERENS MISE-
RÆ SOLATIA VITÆ.

It appears from this, how much the Doctor has told the World that they are indebted to that MAN, to whom they owe the Advantages that arife to them from the Newtonian Philofophy. Let us next fee who this Perfon is, to whom we are in the Doctor's Judgment fo deeply indebted. And who fhould this fame Perfon be, but the Doctor himfelf, tho' he is fo very modeft as not to tell us fo: For tho' the Invention was Sir Ifaac Newton's, and tho' the World may efteem him for his Invention, yet they are not obliged to him for

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the Advantages of it ; for he would not have been so Publick-spirited as to have communicated to us this valuable Secret, but like the Sluggard in the Gospel, would have hid his Talent in a Napkin, if Dr. Halley had not interposed in our Behalf: As Sir Isaac himself very honestly acknowledges in his Preface. Vir Acutissimus & in omni literarum genere eruditissimus Edmundus Halleius, &c. AUTHOR FUIT ut horum editionem aggrederer, quippe rogare non destitit &c. The Learned Dr. Halley was the AUTHOR of my publishing this Scheme of Philosophy to the World, for he never ceased importuning me, till he obtain'd his Desire, &c.

It is then to the Doctor that we are obliged for the Advantages that arise to us from the Newtonian Philosophy, since he was the Author of communicating it to us: For what could we have been the better for Mr. Newton's Invention, if it had not been publish'd? Nay, we are not only obliged to him for his having been the Cause of Publishing that Philosophy, but also for his having made it the Business of his Life, to cultivate and improve his Gift to Mankind.

Let any Man compare the Doctor's Interest in the Newtonian Philosophy, as it appears from what has been said, with the Title of my Book, and see whether they can then believe the Doctor to be a disinterested Judge of my Performance: And as for his Integrity in Judging in that Affair, he has given such a sufficient Specimen of it, in that ridiculous and impudent Praise of the Part which himself acted, as that no Man I think can suspect him of Integrity.

After

After having suggested the Reflection of Dr. Halley's Unfitness to Judge of these Remarks, I am convinced that they who condemned them upon his Authority, will be as ready to accuse themselves of Dullness, as I was to accuse myself; and that they who did not condemn me upon that Authority, will be as ready to accuse those who did, as my Friend was to accuse me for my Rashness.

Though at first the Doctor's Authority was only alledged against me, yet in a short Time I found the Report of my Book's Silliness, built upon the Authority of some others; for tho' the Doctor's superior Interest and Concern made him engage first, and most strenuously in the Affair, it was not to be imagined that some other great Men, who were concerned as well as he, would leave him destitute of Assistance; for they have paid their Tribute of Praise to that Excellent Philosophy, as well as he: And it is only to be attributed to the Doctor's superior Genius, and more near Concern, that his Encomium is more Lofly than their's; since every One has commended according to his Ability, and not the Merit of the Thing, as well as the Doctor; and not only commended, but cultivated and improv'd it, and every Way engag'd themselves in its Defence, tho' not so deeply as he, yet in Proportion to their Abilities; and it is not to be question'd but their Endeavours in opposing my Remarks, would bear the same Proportion to those of the Doctor; and I must own that their Judgments of my Performance, are less to be suspected than his in that Proportion also: For it were unfair to suspect them of exerting themselves against me beyond their Abilities.

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I continu'd to importune my Acquaintances to enquire if any Body had any Thing to allege against me beside Authority; but for a long Time they could hear of no particular Fault in my Reasoning, pointed at by any Man: For they who opposed me, were very cautious of proposing any Objections, especially to such as they had any Reason to think were enquiring upon my Account, lest they should afford me an Opportunity of shewing the World how little they had to say for themselves, by exposing the Weakness of those Objections: So that I almost despaired of ever hearing what were my Errors, till I at last thought of the following Expedient.

I knew that one Mr. Williams at that Time Lectur'd to the Mathematical Club, upon the Subject of Newton's Principia, and happen'd in Course to be upon those Propositions in the Beginning of the First Book, against which I object. This I imagin'd would lay an Obligation upon that Gentleman, not to decline giving some other Reason than Authority for condemning as he did my Remarks. I prevail'd with a Member of that Club to read my Book, and put the Question to Mr. Williams, who answer'd as every Body did, that it was silly; and that there was nothing at all in it. But he who enquir'd, knowing better, would not be satisfy'd with this Answer; and desir'd Mr. Williams to point out the particular Faults which he found in it. He then pointed at my First Objection against Sir Isaac Newton's 2d Prop. B. 1. where I show that Two, or any other Number of Forces, None of which are Centripetal, may produce the Curve in Question; tho' he pretends to Demonstrate that it must be a Centripetal

centripetal Force which produces that Effect: And from thence afterwards takes it for granted, that it must be the Attraction of the Body in the Center. This Objection, Mr. Williams said was very unjust, since Sir Isaac affirmed nothing of Attraction; but that for any Thing he had said, it might be an Angel that carry'd about the Stars, and kept them in their Orbits.

The plain Injustice of this Objection, I do not impute to any Design of injuring me, because I see in the Objection it self, the real Mistake of him who made it; for the Centripetal Force, of which Sir Isaac speaks in his second Proposition, Book 1. seems to be only a mathematical Force, or abstract Quantity of Force, not a real or Physical one: So that if he had not apply'd this Proposition to the proving in Physicks a real Centripetal Force, my Argument had been unfair; and beside, Sir Isaac does not in this place affirm any Thing of Attraction: So that if my Objection were against that Proposition as it lay, it were highly unjust, as Mr. Williams imagined it to be. And tho' I do not make the Objection against that Proposition as it is in it self, but as it is applied in the Third Book. So that the Objection as it is made is certainly just, yet I suppose Mr. Williams did not see how just it was against the Proposition as there applied, because he had not (it seems) in the Course of his Studies, surmounted the Two first Books and come at the Third, and so knew not how Sir Isaac makes use of that Proposition, in proving the first three Propositions of his Third Book: for if he had come the Length of these three Propositions, or of the first Cor. Prop. 5.

B. 3.

B. 3. where Sir Isaac takes it for granted, that his Centripetal Force is the Attraction of the Body in the Center, even such an Attraction as is performed by the Action of that Body; and from this his Supposition, by the Law of Action and Reaction, proves, that the moving Body also attracts the Body in the Center, without pretending to show any Phenomenon of this last Attraction; but founding his Demonstration of it upon his own Supposition. And from that Demonstration also deducing an universal Attraction in the following Corollaries and Propositions, altogether without Phænomena. If (I say) Mr. Williams had come this Length in Newton's Principia, I persuade my self that he would not have made such an Objection.

My Friend not being satisfied with this Objection, beg'd of Mr. Williams to consider the Matter a little better, and to meet with me and shew me my Faults more fully, which Mr. Williams undertook to do; but said, that it would be fittest to put these Faults in Writing, and that an Interview betwixt him and me would perhaps not so well answer the End. This Proposal my Friend very gladly embraced, knowing that above all Things, I wanted to have the Objections that were made against me, in Writing, and came immediately and told me what a considerable Point he had gained, in getting a Promise of that Nature; but I was not so fond of the Promise as he; and told him plainly, that tho' by Mr. Williams's way of promising I knew him to be sincere, yet I would lay any Odds, that he should not perform, when upon trial he understood a little better the nature of the Task which he had taken in Hand. And so it

hap-

happen'd, for my Friend could never get any of those written Objections, nor any more by Word from him since.

The same Person who enquired of Mr. Williams, enquired also of Mr. Cun, a Member of the same Club, what were the Faults of these Remarks, and for a long time could get no Answer; but at last, all of a sudden, Mr. Cun desired my Friend to bring me to the Club, and he would disprove my whole Book; but I happen'd at that Time not to be in the way; so that my Friend was obliged to stand the Brunt of these mighty Objections, which were as follows.

His first Objection was against my Third Theorem. He pointed out no Faults in my Reasoning, but endeavour'd to prove the contrary thus. He observed, that I acknowledged the Efficacy of a Virtue spread every way to or from a Center equally, to be upon Surfaces, as the Squares of the Distances; he supposed Solids to consist of an infinite Number of Surfaces: And so from my Concession, and his own Supposition, he very rightly inferred, that the Efficacy of such a Virtue acting upon Solids, must be in the same Proportion to the Distances, as acting upon Surfaces. He might as well have supposed Surfaces to be made up of Lines; and then he might in the same manner have proved the Efficacy of such a Virtue, when acting either upon Surfaces or Solids, to be in proportion to their Distances.

Mr. Cun should have known that the Word Line in Mathematicks, expresses not any real Being, but only an Idea of Length, abstracting from Breadth and Thickness; and also that the Word Surface expresses only the Idea of Length and
Breadth,

Breadth, abstracting from Thickness: it being certain that these Words can express no more than Ideas, since the Things they do express cannot exist; for Length without Breadth and Thickness, or Length and Breadth without Thickness, which are express'd by these Words, cannot exist; because wherever any one of these Dimensions are, there they all Three must necessarily be; but they can be separately considered, and our Conceptions or Ideas of them, is all that the Words Line and Surface express; but the three Dimensions together, which are express'd by the word Solid, have a real Existence in Nature, so that the word Solid expresses a real Being: And when in the Mathematical way we speak of any Thing acting upon Lines or Surfaces, we do not mean that it acts upon our Ideas, but that it acts upon Solids, as they are extended in Length only, or as they are extended in Length and Breadth only: And when we say, that it acts upon the whole solid Content, we mean, that it acts upon Solids, as they are every way extended in Length, Breadth, and Thickness. All this, I say, Mr. Cun should have known; and if he had known a Surface to be an Idea only, he must also have known that it would require more Arithmetick than he is Master of, to find out how many Ideas go to make up a solid Body.

But tho' Mr. Cun had not known whether the Word Surface in Mathematicks express'd a real Being, or an Idea only, as in Truth our vulgar Mathematicians do not; and Mr. Cun's Education gives no room to expect any thing extraordinary from him; yet if he is not more ignorant than the common Professors of Mathematicks, he must

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must know thus much, that whatever it be that is express'd by the Word *Surface*, it has no *Thick-ness*; for if *Thickness* be added, tho' in ever so small Quantity, to the Length and Breadth, which every Body knows to be express'd by that Word, it has trine Dimension and becomes a Solid. So that if Mr. Cun knew but thus much of the Matter, he must also have known, that No-thicknesses added together, would not make up *Thickness*; and that even the Word *Infinite*, which is so often useful to those who either understand not what they say, or want not to be understood, could here do him no Service; for those who think fit to talk of infinite Numbers and Quantities, allow that an infinite Number of Nothings will not make up Something.

Mr. Cun objected also against my fourth Theorem, where I demonstrate, that if the Tides be raised by the Moon's Attraction, the Tide under her *Ceteris Paribus* must be higher than that on the other Hemisphere. He said nothing against my Reasoning, nor endeavoured to make appear, that Sir Isaac Newton, or Dr. Gregory, have shewed any imparity sufficient to account for the Equality of the Tides; but he fell upon a Method of his own inventing, to account for this Equality. For whereas these Authors, in accounting for the Tides from the Moon's Attraction, conceive the Earth to be at rest, as it really is in respect of the Moon; Mr. Cun supposes the Earth to be moving towards the Moon. 'When the Earth (says he) falls from Tangents towards the Moon, all the Parts of the dry Land being connected together, must move towards her with equal Velocity; but the Waters being
Fluid,

• Fluid, that Part of them which is under the
 • Moon, and is more attracted by her than the
 • whole Body of the Earth taken together, as be-
 • ing nearer, must move faster toward the Moon
 • than the rest of the Earth ; and that part of
 • the Water which is Diametrically opposite, be-
 • ing more distant and less attracted than the
 • whole Body of the Earth, must be somewhat
 • backward in its approaches to the Moon, which
 • must occasion the two Protuberances of Water,
 • which we call Tides.

When Mr. Cun was busy, supporting and ex-
 plaining his Account of the Causes of the Tides, my
 Friend put him in mind, that it was toward the
 Sun, and not toward the Moon ; that the Earth
 fell from Tangents ; and that if this were the
 Cause, these Protuberances must always point to
 and from the Sun, which spoilt Mr. Cun's fine
 Fancy, and put him quite out of Humour. In
 short, he was fain to turn into Passion, which is
 the only way that Men have to keep themselves in
 Countenance when they are catch'd in such gross
 Blunders ; and was so highly offended, that he
 could not be prevailed with to point out any more
 of my Faults at that Time, nor to condescend to
 meet with me to do so at any other Time, tho' he
 said he could easily disprove all my Book, if it
 were worth his while.

I am at a Loss in judging from Mr. Cun's
 Objections, whether they proceeded from Ignorance
 or Design ; but thus much appears from his Con-
 duct, that he is very strenuous in opposing my
 Remarks, tho' he has nothing to say against them ;
 and since he appears to be no ways interested in
 The Newtonian Philosophy himself, as having no
 Reputa-

Reputation that way, I must take the Freedom to tell him, if he knows it not, that he is only a Tool in the Hands of Men of Reputation, made use of by them to hand about among ignorant People, such Objections as they could not themselves own, without injuring their Reputation. And I see by this, by the written Objections which were shewed to Mr. Græme at Edinburgh, and by some other Stories of that nature, which for brevity I omit, that tho' those who condemn me will not give their Reasons for so doing in print, nor let me hear of them any other way, yet they take Care to hand about some Objections to be proposed to proper Persons, which is highly unjust; for if these Remarks deserve no Answer, why should any Answer be given? And why should not every Man be left to himself in judging? Or if it be worth while to make any Answer, or propose any Objections against me, why is it not done in the same open manner in which I have proposed my Objections against the Newtonian Philosophy? that I may have the Privilege of canvassing their Objections against me, as they have the Privilege of canvassing my Objections against them.

This Management is not only unjust, but the most hurtful to me of any; for tho' in these Remarks I have pointed out the chief Errors of the Reasoning that supports the Newtonian Philosophy, yet I have not endeavoured to discover to the World such of their Mistakes as have made those Errors insensible to them: And since they lie under those Mistakes still, it is easy to frame Objections against my Arguments, whose Defects may by these same Mistakes be covered from View,

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and by keeping up such Objections from me, to hinder their Weakness from being exposed, and get them to pass currant.

I had several Reasons for not undertaking to discover to the World such of their Mistakes as have made the Errors of the Newtonian Philosophy insensible to them, but the chief was this; I saw that the doing so would bear very hard upon the Esteem that Men have for the Abettors of that Philosophy, whose Reputation I was not willing to attack any farther than was needful, in order to disabuse the World of those gross Errors in Physicks, into which these Men have led them; and I reflected, that if by sheltering unjust Objections against me under these Mistakes, they obliged me to shew them, I should have the solid Excuse of Self-Defence for what I did that way.

Notwithstanding my Care not to give these Men any just ground of Offence, they are as much offended as if I had done them a great Injury, and accuse me for daring to make so bold as I have done, with the Character of so great a Man as Sir Isaac Newton. If I had in the same manner made bold to charge Aristotle, Plato, Epicurus, and all the great Men who have proposed Schemes of Philosophy to the World, I should not have been charged with too much boldness.

—Nulli gravis est percussus Achilles.

Pone Tigellinum. ————— Juv.

And yet I am persuaded that any of the Admirers of Sir Isaac Newton, who are furnished with a tolerable Stock of Modesty, will hardly
ven-

venture to prefer him to all those great Men; so that it is not the Reason of the Thing that makes them accuse me for using too much freedom with him, or that there is any more ground for looking upon his Person or Philosophy to be sacred, than theirs. But this Charge proceeds only from the Resentment which arises from their being interested in him and his Philosophy.

Those Men, I know, will think nothing good - Manners to them and their Philosophy, but such an implicit Submission, and such fulsome Praises as they are accustomed to; and therefore it is in vain for me to endeavour satisfying them in that Point: so that without any farther regard to them, I shall give the Reader an Instance or two of such common Mistakes as have made the Errors of the Newtonian Philosophy insensible to the World, which will, I hope, not only cut off all Objections that lean upon these Mistakes, but make all others suspected which are not proposed in such a manner as that I have the Freedom of examining their Sufficiency.

First then, Men are ready to mistake Mathematical for real or physical Quantities; the Difference betwixt which I shall endeavour to shew by a familiar Example. If two Horses, pulling in different Directions, draw a Stone; the Force that is actually impressed upon the Stone by each of the Horses, is a physical Quantity; that is to say, a Thing that really is, or has an actual Being in Nature. But if a Mathematician takes these two Forces under his Consideration, he will compound them into one Force, directed as the Diagonal of a Paralelogram, in the Direction of

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whose Sides the Horses pull; or he will dissolve those Forces into Four, or into any Number of Forces he pleases: and these compound and dissolved Forces are Mathematical Quantities; that is to say, Ideas only, or Things that have no real Being in Nature, any where, but in the Mind of him who conceives them.

It's plain, that these Mathematical Forces are not real ones; for if a real Force were impress'd upon the Stone, in the Direction of the Diagonal, that is, if the Mathematicians compound Force were a real one, the Stone must move twice so fast as it does by the Addition of this Force, to the Forces of the two Pulls of the Horses. Neither can it be said that these Two and that One are the same; for certainly two Pulls are different from but One, and a Pull in one Direction is in it self different from a Pull in another Direction: Their Quantities also differ as the Length of the two Sides of a Paralelogram differs from the Length of its Diagonal. In short, these Forces agree in nothing, but that they produce like Motions; and it's for that Reason, that a Mathematician (whose Business is from the Quantity of a Force given to determine the Quantity of the Motion which that Force must produce) takes them for the same; because they are of the same Value to him in his way. But tho' these Forces which are in themselves very different, be alike to a Mathematician for his Purposes, it must seem as ridiculous to a Man that understands Natural Philosophy, to see a Mathematician taking those Forces for the same Thing in Physicks, as it would do to a Mathematician to hear a Porter affirming,
that

that a Globe and a Cube of equal Weight were the same in Mathematicks, because they are the same to him in his way of Business.

It's strange that our Mathematicians, when they compound and divide Forces with such Ease, do not reflect that real Beings are more untoward, than to allow themselves to be thus chopped and changed; and that they are doing nothing all the while, but turning and winding their own Ideas: And it's odd that they cannot find out that the real Forces of Nature suffer no Alteration in their Beings or Modifications, by their Way of Compounding and dividing them.

This Mistake of taking Mathematical for Physical Quantities, is One of those many Mistakes which have made the Errors of the Newtonian Philosophy go down so well with the World: To shew which, I shall also give an Instance of One Error in that Philosophy, which is shelter'd under this Mistake. Sir Isaac Newton, in the first Three Propositions of his Third Book, employs a Centripetal Force, to turn from streight Lines all the Planets, and keep them in their Orbits; which Work I think must require a Real Force: But Sir Isaac's Force is not such, but a Mathematical or Compound Force only, as appears from the 2d Prop. Book 1. and least any Man should not from that Proposition it self have discern'd what sort of Force this is, Sir Isaac adds a Scholium to his Proposition, on Purpose to tell them that the Force in the Proposition is a Compound Force.

I know not whether the Brevity which I am confined to, has allow'd me to explain this Mistake, and shew the Error that depends upon it,

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so as to make them evident to every Capacity; but I am inclin'd to believe that most Men of Learning will understand me; and to All such as do, Sir Isaac Newton and his Party, in Spite of their great Reputation, must appear to be of that Rank of Mathematicians, who tho' they can talk of Lines, Surfaces, Forces, and other Mathematical Quantities, so as to answer many useful Ends, yet know not what they speak of, and cannot tell whether those Things which are so familiar to them, have any Being in Nature: And notwithstanding their Reputation for having so highly improv'd Physicks by the Help of Mathematicks, must appear not to have so much as known what these Sciences were, since they could not distinguish the Subject of the One from the Subject of the Other. Sir Isaac Newton, I say, and his Followers, must appear to All those who understand the Difference betwixt Mathematical and Physical Quantities thus Ignorant, in Spite of their Reputation; or else to have had a Design of proposing and commending to Men a System of the World, modell'd by their Ideas only, and govern'd by a Cause which they understood to have no Existence, save in their own Imagination: And this is so hard a Dilemma, that I was loath in my Remarks to reduce them to it, by explaining the Matter fully. And that it may appear that it was this, and not Diffidence of the Soundness of what I have now said, which made me not say it in the Remarks, I promise that if any Man can by a good Argument clear them of that Dilemma, I shall for the Sake of that One Argument renounce these Remarks, and believe every Thing that

that he who proposes the Argument pleases to affirm in any Subject.

I shall only stay to instance One Mistake more, which All they who have embrac'd the Newtonian Philosophy lie under. Sir Isaac Newton and Dr. Gregory do in their Way demonstrate, that the Attraction of the Sun upon the Earth, causes the Earth to describe round the Sun an Ellipsis and Areas proportionable to the Times, to Mathematical Exactness; and that the same Attraction of the Sun upon the Moon, which according to them is an equal accelerating Force, must cause the Moon to accompany the Earth in its Orbit, to the same Exactness; while the Earth's Attraction makes the Moon also describe round it an Ellipsis and Areas proportionable to the Times also to like Exactness: So that at this Rate, the Attractions of the Sun and Earth upon the Moon, are sufficient to Mathematical Exactness for producing the Moon's Motion, if it were absolutely regular: Or which is all one, the adequate Effect of these Two Attractions upon the Moon, is the Moon's Motion, if it were regular; but it is far from being such; and therefore the Question with our Philosophers was, to find out the Cause of these Irregularities, and what should they take for this Use but the Attraction of the Sun? That is to say, Take the Cause whose adequate Effect is to produce the regular Motion, and employ it to disturb its own adequate Effect. It was no less than Necessity that forc'd our Philosophers to make so hard a shift for a Cause to produce the Moon's Irregularities: For since they keep Time with her Situations in Respect of the
Sun,

un, if they had taken them from any other Cause, the Phænomena would have cry'd aloud against them. I know not how to set this Mistake in a better Light, than by telling a Story of a Mistake of the same Nature, in a familiar Case.

They tell of an Irishman, (for true or false, such Stories are told of them) that when he came to Town, he went to a Corn-chandler's to buy Oats for his Horse, but forgot to carry something to put them in, and was obliged to take his Hat for that Use. After it was full to the Brim, there remained still some Oats in the Measure, and the Chandler ask'd him in what he would put the rest; He very readily bethought himself that his Hat could carry Oats upon the one Side as well as upon the other, and turn'd up the other Side of his Hat to hold the rest, without reflecting that by his so doing, he must spill the Oats that were already put in.

Sir Isaac Newton's Mistake (if it was not Design) in employing the Sun's Attraction upon the Moon to produce more than its adequate Effect, is the very same with the Irishman's, in putting more Oats in his Hat than its Fill: And yet upon this gross Mistake the so much admir'd Theory of the Moon's Motion is built, of which Mistake the Reader will easily discern that I shun'd to speak in the Remarks.

I have now, Reader, said what I thought necessary for guarding you against the indirect Management of those who oppose my Remarks; I must beg your Patience yet a little, till I make some few Reflections upon the whole Matter.

Tho' any Man who has the least Taste of Natural Philosophy or Mathematicks, is in some Measure able to judge of these Remarks, yet no Man is able so absolutely to judge in the Matter, as that he can oppose his Judgment to the Judgments of all those famous Men who declare against them; unless he can enter fully into the Subject, and search my Arguments, and those against which I object, to the Bottom; which he cannot do, without a good Taste of Natural Philosophy, Skill in Mathematicks, and a perfect Knowledge of Newton's Principia, his Dialect and Way of thinking; which Qualifications meet but in a few, who are generally interested against me. In short, the Scarcity of those who are conscious of being capable to judge for themselves, is what makes so many take all upon Trust, and consequently condemn me; whereas, had the Subject been generally understood, the Evidence of these Remarks is such, that it would have been impossible to support the Newtonian Philosophy against them in the Eyes of the World.

The Scarcity then of People capable to judge in the Matter, is what exposes me so much to the Lash of the Authority of those who are interested against me. And for this Evil, I hope, I have now found a Remedy; for I shall shew every Reader of whatever Capacity or Knowledge he be, how he may safely judge in the Affair.

First then, the Conduct of those who oppose me shews, that their Opposition proceeds from something else than Contempt of my Arguments, which is pretended; for if my Arguments be silly, Why should so much Pains be taken to hinder the World from seeing

seeing them, as appears in the above Narration to have been taken for that End? Or if they be worth so much Trouble as these Managements must have cost, How can they be unworthy the much less Trouble of an Answer? Nay, if my Reasonings be so grossly silly as is pretended, How comes it to pass that not only None of my Acquaintances can see it, but that None of those who pretend to see it, can be prevail'd with to point it out: Or rather, Why do they who endeavour to shew my Errors, shew their own gross Blunders instead of them? But why should I insist upon a Point which is so plain; for certainly, without my saying any more upon the Head, no Man that believes the Facts which I have narrated, can hinder himself from seeing whence the Management proceeded. And no Man can in Justice question the Truth of these Facts, because as far as was needful or could be done, without injuring particular Persons, I have added Names and Circumstances, which is all the Satisfaction that can be given, or ought to be expected in such Cases.

But that this may hinder no Man in Judging, I shall shew another Method perfectly sure and independent of Matters of Fact, Knowledge of the Subject, or any Thing but Common Sense, which is this; The Charge that is brought against these Remarks is, that they are silly and not worth answering. Let us then see what Sort of Silliness it is in Objections which are made against the Opinions of a Party, that is sufficient to excuse Answering.

It's plain, that every Objection which is not perfectly good and sound, tho' ever so plausible in
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Shew and Appearance, when search'd to the Bottom by Men of sufficient Penetration for discovering its Defects, appears to such to be silly, weak, gross, or to deserve any of these Epithets which open Falshood deserves; but it is not enough to excuse answering such an Objection, that Men of deep Reach see it to be silly; for if those of ordinary Capacity see it not, they make up so considerable a Part of Mankind, that such as do see it ought to shew it to them also; which is answering the Objection: So that neither real Silliness, that is to say, Falshood of an Objection, nor such Silliness as appears to None but Men of a deep Reach, are sufficient to justify not answering an Objection, but such Silliness only as appears to Men of ordinary Capacities without being shewed them; and since every Man of ordinary Capacity can judge what does of its own Accord sufficiently appear to him so, every Man of ordinary Capacity can judge whether these Remarks are so silly as to deserve no Answer; and there being but Two possible Reasons for a Party's not answering Objections, that are so directly made against them as those of mine are, viz. either that the Objections are not worth answering, or that they are unanswerable: He who judges that the Former is not the Reason of not answering my Arguments, must judge it to be the Latter.

I am also represented to be as silly as my Remarks, and insulted in a very haughty Manner for being the only Person that cannot see my own Error; and I must do my Opponents the Justice, to own that the One is a very necessary Consequence of the Other: For if my Remarks be so grossly

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grossly silly as they are said to be, I must be the silliest Creature in Human Shape, not only in not being able to find out that which appeared so well to all the World, but in continuing now to shew my Silliness further to the World, and in provoking those also to do it, who have shew'd so much Willingness to drop the Subject, and so much Regard for my Character, as to put themselves to a great deal of Trouble in hindering the World from reading my Silliness in my Book.

It's plain, I say, that if my Remarks be so silly as they are represented, I must be exceeding silly; and it is a necessary Consequence of this, that if I am not exceeding silly, my Remarks are not what they are represented to be. Now it's observable, that all Imperfections of the Mind, except Silliness alone, may be disguised and covered from the Eyes of the World; and that it is the Property of that Imperfection only, that it self is inconsistent with its being disguised. And hence it is, that he who is extremely silly discovers his Silliness to all Men of ordinary Capacities equally in every Thing he does, says or writes upon whatever Subject, and carries it as conspicuous about with him, as if it were branded upon his Forehead. And they who understand nothing of the Subject of these Remarks may yet, from what I have said in this Preface, upon a Subject that must necessarily be understood by every one that reads any sort of Books, discover my Silliness, if I am exceeding silly; or if they discover no such gross Silliness, may safely conclude, that these Remarks cannot be such.

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When these Remarks were publish'd, some of my Opponents essayed to give a moderate Character of them at first; and said, that I had mistaken Sir Isaac's Meaning; and that they did not wonder at it, for they themselves ran into the very same Mistakes, till they fully understood the Subject. There was abundance of Policy in making choice of this Report, for it is a certain Rule of Prudence with those who are obliged to use Falshoods in their own Defence, to make choice of such as are near to Truth; for if the Difference be wide, it the easier appears. Now here was but a very imperceptible Difference betwixt this Falshood and the Truth; for they who made use of this Charge, did in effect own that my Objections were such as might appear just to every one that did not thoroughly understand the Subject; and such Objections have the greatest Resemblance to just ones. And the Advantage of this Report was, that by it every Man was directly cut off from judging in the Matter, but such as perfectly understood the Subject.

This Report, however advantageous it was in its near Resemblance to Truth, which made it most tenible, yet did not please the Leading Men of the Party; and it was no Wonder; for if that Report had been made Choice of, then why not answer my Remarks? They saw very well that no moderate Charge against them, nor any Thing less than gross Silliness would excuse answering; and since answering was at any Rate to be avoided, Silliness must be pretended: And as soon as the Word Silly came from above, those very Persons, who had given a Moderate Character before,
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changed their Note, and cry'd Silly as fast as any Body.

Tho' of the Two, this was certainly the most advantageous Report for them, yet by excusing themselves thus from answering, they laid themselves open upon the other Side, and were obliged to go so wide of the Truth, as to leave the Difference sensible to Men of ordinary Capacities. Thus it still fares with those who make use of Lyes and Falshood to defend themselves; for there is something so monstrous in the Nature of Falshood, as that it can scarce be every Way hid, but may be made appear upon some Side or other.

I have shew'd you, Reader, whoever you be, of whatever Degree of Knowledge or Capacity, how to judge safely of these Remarks. I now beg of such of you as have any Value for the excellent Science of Nature, to assist me in rescuing her from the Hands of those Men, who have for a great while kept her Captive, and barr'd all Access to her, by amusing the World with Fiction instead of her. I intreat also of such of you, as have any Regard for the useful Science of Mathematicks, that you will join in clearing that Virgin Science of Errors and Sophistry, with which she is now defiled, by a Set of Men, who have prostituted her intire Character of Veracity, for passing upon the World their gross Fictions instead of Philosophy; which nothing less than the Credit of Mathematical Demonstrations could have made Men swallow. And lastly, I beg of such of you, as value Truth as such in Opposition to Error, whether you have any Regard for these Sciences or not,
and


and who would not choose to deliver up unguarded Innocence into the Hands of Calumny and Oppression, or the World to be abused by designing Men; of which last Sort, I hope all Readers are; to assist me in vindicating the Cause of Truth and my own Innocence, in shewing the World how they are abused: What I intreat is, that you will not suspend your Judgment; for as Matters stand, that is equivalent to your condemning me; but since I have shewed every Man how he may safely judge, I beg of all of you to judge positively in the Matter, as it appears to you. And I must give you this further Caution in judging, that if you should happen to Err, as I perswade myself after what is said you will not, yet remember how much more safe it is for you to Err on the one Side than on the other: For if either by suspending your Judgment or pronouncing against me, you condemn me unjustly, you sacrifice those Two excellent Sciences to Error, Truth to Falshood, Innocence to Calumny, and the World to be abused by designing Men: Whereas if you Err in acquitting me of the heavy Charge that is brought against me, you do no more Harm, than to oblige those who have been at so much Pains already about the Newtonian Philosophy, to be at the inconsiderable Trouble of answering a few weak Objections.



REMARKS

UPON THE

Newtonian Philosophy.



HERE is nothing to which the Philosophers of all Ages have so generally applied themselves, as to the Study of Nature ; and there is no Study in which they have been able to make so little Progress as in this ; especially in that Part of it which is employ'd in discovering the Causes of the beautiful Order and steady Motions of the Sun, Moon and Stars : And if we consider their Schemes of this Part of Natural Philosophy, we shall find them All built either upon gross Absurdities, or Words without Meaning ;

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ing ; and evidently see that Human Understanding, even in its greatest Perfection, is very unequal to so hard a Task as the searching out this mysterious Cause.

Our Philosophers have now got into a Way of treating that Part of Natural Philosophy in the same Method with Mathematicks ; and by this Management, propose to make it more certain than formerly, and to get Mathematical Demonstration to determine this Point, which has deceived so many of their Predecessors. It is most certain that Mathematicks give very great Assistance to Natural Philosophy ; but I cannot see the Advantage of handling Natural Philosophy it self, in the same Method as Mathematicks ; and am inclined to believe, that our Modern Philosophers have made use of the Mathematical Way, rather because the Study of Mathematicks (to which they were most accustomed) had made that Method most easy and familiar to them, than for
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any real Advantage there is in handling Natural Philosophy in such a Manner. For though it be true that the Thing which is most wanted in Natural Philosophy, is to make its Propositions more certain, and that the Proofs of Mathematicks are of all others the most certain; yet this Certainty in the Proofs of Mathematical Propositions, arises from the Nature of the Subject of that Science, and not from its Method. For it is because we have clearer Ideas of the Relations of Quantities, the Subject of Mathematicks, than of the positive Properties of real Beings, the Subject of Natural Philosophy, that the Propositions of the former Science can be proved more clearly than those of the latter; and not because in the one Science we have a better Method of proposing our Reasons, than in the other. It's true, the Method of proving Mathematical Propositions, is the fittest for shewing such an evident Chain of Connexion as those

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Propositions have with the clearest Principles, because there is no more to be done, but in a plain easy Manner to express this Connexion, which when barely propos'd, shines by its own Light : But there is so little Evidence in many of the Principles upon which Natural Philosophy depends, and the Chain of Connexion is so dark, that methinks no Man should attempt to shew it in the same easy and peremptory Method with Mathematical Demonstrations ; and in my Opinion, the Mathematical Method, instead of being an Advantage to Natural Philosophy, is as unfit for it, as for the Disputes of the Bar, or those of the Cabinet-Councils of Princes.

But whatever Advantage or Disadvantage there be in this Method of handling Natural Philosophy, and of proving its Propositions, yet these Proofs can never be Mathematical Demonstrations ; nor can they be made better by any Method, than their own Nature, and the Nature
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of their Subject will allow. So that notwithstanding our Modern Natural Philosophy is proposed to the World in a Mathematical Dress, it is Natural Philosophy still, and not Mathematicks. It is that same Science which has so often deceived the greatest Philosophers, in which the greatest of Men have been often convicted, and are still to be suspected of Errors; and not that Science, in which any Man of common Sense is capable to force the Assent of the most stubborn and subtil Disputant. So that I see no Reason why the Dress of this Philosophy should cause Men to stand so much in Awe to examine its Sufficiencies as they do.

The Account we have of the new found Cause, which, according to this new Philosophy, keeps the whole System of the Universe in Order, makes that Philosophy to me seem much to be suspected. The famous Sir *Isaac Newton*, its Author, tells

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tells us, * That it is a Virtue or Power which Bodies have to attract or draw one another ; that every Particle of Matter has this Power or Virtue ; that it reaches to all Places at all Distances, and penetrates to the Center of the Sun and Planets ; that it acts not upon the Surfaces of Bodies as other Natural Agents, but upon their whole Substance or solid Content, &c. and if so, what a strange Thing must it be.

I confess that the many Instances of unintelligible Causes that have been assigned by the greatest Philosophers for the Production of those surprizing Phænomena of the Motions of the Heavens, make me suspect this Cause, which looks as monstrous as any of the Fictions of Antiquity ; and the Mathematical Dress of the Arguments which support that Cause, does not hinder me from suspecting their Sufficiency: And I perswade my self, that my *Re-*

* Page ult. *Prin. Math. and elsewhere.*

marks upon those Arguments will neither be useless nor disagreeable to the Learned World.

The Chief Persons who have propos'd to the World this Scheme of Physicks, and the Reasons that support it are, Sir *Isaac Newton*, in his *Principia Philosophiæ*, and Dr. *Gregory*, in his *Principia Astronomiæ Phisicæ*, &c. and to avoid Confusion, I shall take these Reasons from those Authors only.

Mr. *Newton*, L. 3. Prop. 1. asserts of the *Satellites* of *Jupiter* and *Saturn*, that they are hindred from moving in streight Lines, (which Bodies naturally affect) and kept in their Orbits, by a Force directed to *Jupiter* and *Saturn*. Prop. 2. He asserts of all the Primary Planets, that they are hindred from running out in streight Lines, and kept in their Orbits, by a Force directed to the Sun. And Prop. 3. He asserts of the Moon, that she is kept in her Orbit by a Force directed to the

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Earth;

Earth; and for Proof of these Three Assertions, refers to his Account of the *Phænomena* of the Motions of those Bodies, and to his 2d and 3d Prop. of his 1st Book.

The *Phænomena* to which he refers are, that the *Satellites* of *Jupiter* and *Saturn* appear to move so, round *Jupiter* and *Saturn*, the Primary Planets round the Sun, and the Moon round the Earth, as to describe round them Areas proportionable to the Times; by which he means that the Areas comprehended within any Parts of the Curve which those Bodies describe, and Lines drawn from both Ends of those Parts to that Body round which they move, are as the Times in which the Body did describe those Parts of the Curve.

It may be very true that the *Satellites* of *Jupiter* and *Saturn* describe round *Jupiter* and *Saturn*, the Primary Planets round the Sun, and the Moon round the Earth, Areas proportionable to the Times; but
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this neither does nor can appear to any great Exactness from Observation, at least if order'd by Rules independent of Mr. *Newton's* Philosophy; and to infer from Rules depending upon that Philosophy, that the Planets describe such Curves, and from their describing such Curves again to prove that Philosophy, is not fair Reasoning. Nay, according to Mr. *Newton* himself, it cannot appear that these Bodies describe such Curves, because by the Prosecution of his Subject, he is forced * afterwards to affirm of all the Planets, particularly of *Jupiter, Saturn,* and the Earth, that they do not move in that Manner. Notwithstanding, I shall not insist upon this; but suppose that the Planets appear to move as Mr. *Newton* says.

In the 2d and 3d Prop. of his 1st Book, he asserts, that all Bodies moving in any Curve, which in a Plan describes round any other Bo-

dy (whether in Motion or at Rest,) Areas proportionable to the Times, are forced into such a Curve by a Force directed to that Body, round which they describe those Areas. Dr. *Gregory*, in asserting the same Thing, proposes the Case of the Body round which the other revolves being in Motion, and the Case of its being at Rest, seperately, and so sets this Matter in a clearer Light; whose Method I shall follow, and take first the Case of that Body being at Rest, as he does.

The Demonstration of Mr. *Newton's* 2d Prop. Book 1. and Dr. *Gregory's* 12th Prop. Book 1. where these Authors demonstrate this Case, are in Effect the same; but Dr. *Gregory* proves it more fully, and I shall repeat the Demonstration of this, so as to comprehend what they both say: For it is needless seperately to repeat their Demonstrations, where they differ in nothing, but that the one is more full and clear than the other. And this Method of repeating
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ing their Arguments, I shall observe all along. The Demonstration of Mr. *Newton's* 2d, and Dr. *Gregory's* 12th Prop. is as follows :

Let the moving Body move in the Line $abcde$. Divide this Line into such Parts

ab, bc, cd, de ,

as the Body describes in equal Times.

Let the Body at Rest

be S , draw

$bf=ab$, draw

$aS, bS, fS, cS,$

dS, eS . The

Body in any

certain Time

describing the

Line ab , would if nothing hinder it,

describe in equal Time $bf=ab$, by the

Nature of Bodies in Motion: And

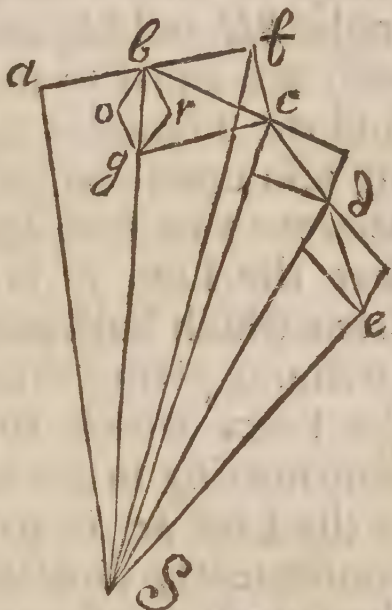
since it describes not bf but bc , it is

turned from moving in bf by some

Force. Suppose by the centripetal

Force bg . The Triangles Sbf and Sab

are



are equal, because their Bases ab and bf are equal, and their Altitude is the same; the Triangles Sbc and Sba are equal, because they are the Areas described in the equal Times ab and bc , and the Areas are *Ex Hypothesi* as the Times; but the Triangles Sbf and Sbc are equal, because both are equal to the Triangle Sab . And the Triangles Sbf and Sbc , being also upon the same Base, Sb are between two Parallels Sb and fc ; so that the Line fc is parallel to Sb . From which both our Authors infer, (without giving their Reason) that the Force which turned the Body from moving in the Line bf , to move in the Line bc , is parallel to cf , and consequently directed to S . And by the same Way of reasoning, it's plain that the Force acting in all the other Points $c, d, e, \&c.$ may also be proved to be directed to S .

The Reason why our Authors conclude that the Force turning the Body from moving in the Line bf , to move in the Line bc , must be
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parallel to cf , is obvious upon drawing the Parallelogram $bfcg$: For both those Authors take it for a known Truth in Mechanicks, that a Body by two Forces joyning, will describe the Diagonal of a Parallelogram, in the same Time it would by any one of those Forces describe one of the Sides. And one of the Forces joyning to produce the Motion bc , being bf , the other must be the other side bg , parallel to its opposite Side cf .

It is observable, that all that can here be inferred is, that the actual Motion of the Body in the Line bc , may be resolved into the Forces bf and bg ; but then it may as well be resolved into bf , bo and br ; as appears by describing the Parallelogram $bo gr$. So that the Forces bo and br , neither of which are directed to S , might have turned the Body from the Motion bf to the Motion bc , as well as the Force bg . And therefore this Demonstration, instead of proving what is asserted, that all
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Bodies endeavouring to move in the Line bf , and really moving in the Line bc , are turned from bf into bc , by a Force directed to S , only proves that it is possible for this Force to turn the Body from bf to bc , since this Force bg is really no more than one of an infinite Number of possible Forces that may turn the Body from bf to bc .

It is to no Purpose to answer, that bo and br , or any Forces which can turn the Body from bf to bc , are equivalent to bg ; that, is when joyned together will produce like Effects with bg . It is plain indeed, that since the Effect of bg in Conjunction with bf is to produce bc ; whatever in Conjunction with bf will also produce bc , is in that Respect equivalent to bg ; but then this does not make appear that any of the Forces bo or br are themselves directed to S , and can give no Satisfaction when the Nature of any real Force that produces any actual Motion is in Question, especially the
actual

actual Motions of Bodies of any considerable Bulk, which are always moved by several Forces joyning together : For Instance, a Ship carry'd in a Stream, and a Man walking on the Ground, may easily be supposed to describe, round some Body or other, Areas proportionable to the Times, to as great Exactness as any Man from Observation can affirm that the Planets do. The Force that moves the Ship, is the Pressure of the Particles of Water upon her Sides, in many Millions of Directions ; and the Force that moves the Man's Body, is the Action of his Animal Spirits contracting his Muscles in as many Directions. Now, what Idea can any Man have of the Nature of any of those two very different Causes, from being told that the whole Forces by which those Motions are perform'd, when joyned together, are equal to one directed to that Body, round which the Ship, or the Man's Body, describe Areas proportionable to the Times?

Times? And what little Reason have we from this, to conclude those very different Causes to be alike? Or what a ridiculous Thing were it, from this to infer that the Ship, or Man, were attracted by some Virtue proceeding from those Bodies, round which they described such Curves, and that this Attraction were the Cause of their Motion? And yet, our Authors have no better Reason from this Proposition, to conclude that the Stars are moved by the Attraction of that Body, which is in the Center, or in one of the Foci of their Orbits.

Notwithstanding what I have said, this Argument would still prove that a Body moving in any Curve, that in a Plan describes round a certain Point Arcs proportionable to the Times, may be forced from a streight Line into those Curves, by a Force directed to that Point: Though it falls far short of proving the positive Affirmation, that all
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Bodies moving in any such Curves, are forced into such Motion by a Force of that Direction. The Difference betwixt these two Proofs is very considerable, for the latter is a Demonstration, *a priori*, and yields an absolute Certainty, that any Body describing such a Curve as the Proposition expresses, must necessarily be actuated by the Cause which the Proposition assigns; whereas the former is only a Demonstration, *a posteriori*, and shows no more than a Possibility, that the Cause assigned in the Proposition may produce the Motion which the Proposition expresses. Now to shew a Certainty that a Thing is so, and a Possibility that it may be so, are very different.

But after all, I have represented this Fault in this Demonstration to be great, only because it is so in Respect of what the Proposition asserts; for this Defect is not in it self so great as some may possibly imagine: For to speak Truth, nothing

thing should have been affirmed but this Possibility; for it's impossible to prove any more in such Cases. Nay, it is a great Matter in Physics, to come this Length, to be absolutely certain that the Cause we assign for an Effect, may possibly produce it, or is no Ways inconsistent with it; which is what we call accounting for an Effect from a Cause. And when an Effect may be accounted for from a Cause, if some considerable Inconvenience in supposing this Cause to produce that Effect do not appear, we reckon our selves certain that that Effect is produced by that Cause: Not that we are strictly speaking certain of it; but because this is the greatest Certainty we can for the most part reach in the abstruse Points of Natural Philosophy. And if Mr. *Newton* had not, by the Habit of affirming Dogmatically in Mathematicks, slipped into a positive Affirmation, that all Bodies moving in such Curves as he defines, are forced into those Curves
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by the Force he condescends on, and had only said that all such Motions might be produced by this Cause; his Argument, notwithstanding the Fault I have observed, if it had no other, would have been a valuable Argument in Natural Philosophy, though not sufficient for a Foundation to that mighty Superstructure that is built on it.

But the Truth of the matter is this, our Authors Argument will not support the Affirmation of a Possibility, that the given Cause can produce the given Effect; which is its great Fault; and if I can make that appear, this Argument will appear to be of no manner of use.

In order to make this appear, let us consider that the Proposition is affirmed of all Bodies moving in any sort of Curves, that in a Plan describe round a certain Point Areas proportionable to the Times. Now there are many very different Kinds or Species of such Curves, to wit, Circles, Elipsis's, Hyperbo-
las,

las, Parabolas, Cicloyds, Spiral Lines; nay, any kind of Curve lying upon a Plan may be performed with such a Motion, as to describe round some certain Point Areas proportionable to the Times. So that this Proposition is affirmed of all sorts of Curves lying in a Plan, provided they be performed by a certain sort of Motion.

It is necessary that this Proposition should have been conceived as it is in general Terms, to make it fit for the use that is made of it; which is to infer from it, that those particular Curves which the Planets describe, may or must be produced by a Centripetal Force. For to justify this Inference, it's plain that the Proposition ought either to prove in general of all Kinds of such Curves, that they may be produced by such a Cause, or at least to prove this of those particular Kinds of such Curves, which the Planets are supposed to describe; and since in this Proposition there is no particular

cular Species of such Curves mentioned, the Proposition must necessarily be understood in the same Terms, in which it is very explicitly conceived, *viz.* to affirm in general of all Curves that in a Plan describe round a certain Point, Areas proportionable to the Times, that they are, or at least may be, produced by a Force directed to that Point, turning the Body that describes these Curves from streight Lines; or if this Proposition is not so understood, it will not serve to prove the 1st, 2d and 3d Prop. L. 3.

It appears very clearly from the Demonstration of Mr. *Newton's* 2d and Dr. *Gregory's* 12th Prop. L. 1. or from those Demonstrations as I have faithfully repeated them, that a Centripetal Force is supposed to produce the Curve of which the Proposition speaks, *viz.* all Curves which in a Plan describe round a Point Areas proportionable to the Times; and it is only demonstrated that the Point round which the Curve describes

scribes those Areas, is the Center or Point to which this Force is directed ; Whereas the main Thing to have been proved, was that a Centripetal Force could produce all or any Species of such Curves ; which is supposed and not proved. Till this be proved, we are uncertain whether it be possible for any Centripetal Force to produce all sorts of Curves that in a Plan describe round a Point Areas proportionable to the Times ; or whether it be possible for a Centripetal Force to produce those particular Kinds of such Curves which the Planets describe : Nay, for any thing we learn, from this Argument it may be demonstrable that such a Force can neither produce all such Curves, nor those particular Species of ~~such~~ Curves which the Planets describe ; and since this Uncertainty is left, and the main Thing that ought to have been proved is supposed only, this whole Argument can be of no manner of use.

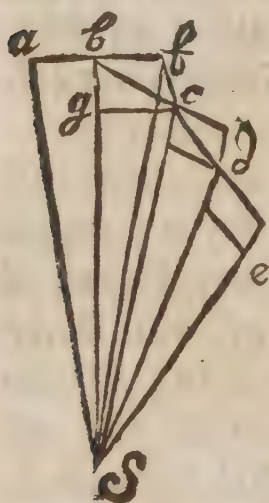
But

But to deal with all the Fairness imaginable in this Matter, it's true that both our Authors have a Proof which to some People may perhaps seem to be a Proof of this Point; and this Proof I shall faithfully repeat, and clearly show that it proves not the Point in Question. This Proof is the Demonstration of Mr. *Newton's* 1st and Dr. *Gregory's* 11th Prop. L. 1. which is as follows:

If a Body move in any Line *af*, and be forced from it by a Centripetal Force directed to any Point, *S* not lying in the Line *af*, the Body will move in a Curve lying in the Plan that passes between *S* and *af*, the Curve will be hollow toward *S*, and describe round it Areas proportionable to the Times. The Demonstration is,

Suppose the Body in any certain Time to describe the Line *ab*, it would by the Nature of Bodies in Motion describe $bf = ab$ in an equal Time if nothing hinder it; and if it is acted upon by the Centripetal Force

Force bg , it will also in equal Time describe the Diagonal of the Parallelogram $bfcg$, viz. the Line bc . The Triangles Sab and Sbf are equal, because their Bases ab and bf are equal, and their Altitude is the same. The Triangle Sbc and Sbf are equal, because on the same Base Sb , and be-



tween the same Parallels Sb and fc ; but Sbc is equal to Sab , because both are equal to Sbf , and these are the Areas described in equal Times ab and bc . By the same Reasoning the Force directed to S , acting again in

the Point c , must force the Body to describe the Area Scd , in the same Time it described the Areas Sab or Sbc ; and so for any Number of such Areas: And if any two Numbers of such Areas be taken, the Sums of these Areas will be to one another as the Sums of their Times; or if these

these Areas be proportionably diminish'd, they will be to one another as before. Let us then suppose our Centripetal Force not to act at different Times upon the Body in distant Points of its Motion, but continually and in every Point of its Motion; and consequently suppose the Lines ab , bc , cd , de , &c, and the Areas comprehended within these Lines, to be diminish'd in Infinitum, so as to bring the Points b , c , d , e , &c. in which the Force is supposed to act, next to one another; then will the Line $abcde$ be a Curve, and the Areas this Curve will describe round S , will be proportionable to the Times as above. It's plain that it will also lie in a Plan, and be hollow towards S , &c.

In this Demonstration it's evident that nothing is proved, but that a Centripetal Force will turn a Body into a Curve, in a Plan describing round this Center Areas proportionable to the Times: that is to say, will produce such a Curve;

B

but

but it neither is asserted nor proved that it can produce all such Curves; neither is there in this Proposition any Species of such Curves mention'd. So that it proves no more than that some sort of Curves, which in a Plan describe round a Point Areas proportionable to the Times, may be produced by a Centripetal Force turning a Body from a streight Line, without showing whether any more than one Species of such Curves can thus be produced, or so much as what that one Species which may be so produced is. So that if that which is supposed in Mr. *Newton's* 2d, and Dr. *Gregory's* 12th Prop. L. 1. viz. That a Centripetal Force can produce all such Curves, be deny'd, there is here no Proof of it; but the Matter is left at an absolute Uncertainty, and we are so far from knowing that a Centripetal Force can produce all Curves, which in a Plan describe round that Center Areas proportionable to the Times, that we know not whether this Cause can
pro-

produce any more then one Species of such Curves: nay, not so much as what this one which it can produce is. And since this Matter is left at such an Uncertainty, I shall prosecute the Demonstration of Mr. *Newton's* 1st and Dr. *Gregory's* 11th Prop. L. 1. and demonstrate in the following *Theorem*, what that Curve is which this Cause can only produce.

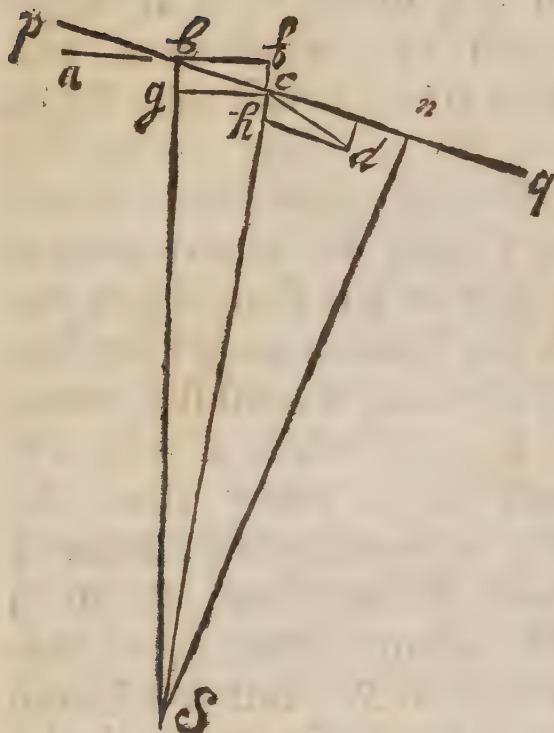
T H E O R E M I.

A Body turned from a streight-lined Motion into a Curve that lies in a Plan, and describes round any Point S, Areas proportionable to the Times, by a continuing Centripetal Force directed to S, must either move constantly away from S, or come constantly nearer to it in a Spiral Line.

Let the Body's streight-lined Motion be the Line *abf*, let the Centripetal Force directed to *S*, be supposed to act upon the Body at the

B 2
Point

Point b , the Line bf in which the Body at b would run out, must make with bs , the Line of the Direction of the Centripetal Force acting in b , either a Right, an Acute, or an Obtuse Angle. If the Angle Sbf be a Right or Acute Angle, then is the Angle Sbc (a Part of that Angle) less than a Right Angle. Draw out bc in Infinitum toward q and p , let us with our Authors conceive the Point c to be the next Point in which the Centripetal Force acts; which being supposed to act continually or in every Point, the Point c must be the next Point to b in the Line bq . Drop a Perpendicular from S , upon the Line pq , it will fall somewhere betwixt b and q ; either upon c the next Point to b in that Line, or upon some other Point betwixt c and q : Suppose upon the Point n . If the Perpendicular fall upon c , then is c the nearest Point in the Line pq to the Point S , nearer to wit than the Point b ; if the Perpendicular fall upon n , then is c nearer to S than b ,
be-



because nearer to n : So that the Centripetal Force meeting with the Line in which the Body would run out at Right Angles,

or less than Right Angles, must necessarily force the Body to move from a Point more distant to a Point less distant from the Center S . The Line $c q$ is that Line in which the Body at c would run out next, and the Point c is the next Point in which the Centripetal Force is supposed to act; but a Perpendicular from S upon $p q$ fell, as above, either upon c ; and then the Force directed to S

acting in the Point c , is at Right Angles with cq ; or upon n , and then is this Force at less than Right Angles with cq . And so by the same Reasoning, if the Force directed to the Center be at any time at Right Angles or less than Right Angles with the Line in which the Body would run out, it must still continue to be so; and while it is so, the Body must move every time the Force acts, or continually, from a Point more distant from S , to a Point less distant from S , or approach nearer to S . But if a Curve be such, that the Lines in which the Body would run out, *viz.* the Tangents of the Curve, make with the Radius constantly more than Right Angles; then is the Body that moves in that Curve moving continually away from S : Or if the Tangent and Radius of this Curve at any time be at Right Angles, or less than Right Angles, then must the moving Body come constantly nearer to the Center S in a Spiral Line. *Q. E. D.*

C O-

COROLLARY.

Hence it appears that neither the Planets, nor their Satellites, nor the Comets, are turn'd from the streight Lines they would necessarily describe, by a Centripetal Force; because the Tangents of them all have been observed at right Angles, or less than right Angles with the Radius; and they have not moved constantly nearer to that Body to which the Radius is directed. Or rather the Planets, and their Satellites, and the Comets, are not turned from streight Lines by a Centripetal Force; because they neither move continually away from the Bodies round which they revolve, nor come constantly nearer to them in a spiral Line.

Since Mr. *Newton's* Natural Philosophy extends no further than to what concerns the System of the Universe; and his whole Scheme of the System of the Universe is built upon this Proposition, which I have

B 4 disproved;

disproved ; and supposes the whole Bodies of that System to move by Centripetal Force, which I have demonstrated to be impossible : What I have said is sufficient to overturn his whole Scheme. But since all his other Reasonings beside their Dependance upon this Argument, which I have disproved, or their Dependance upon one another, are as defective as this which I have consider'd ; I shall, for further Satisfaction upon this Subject, proceed to remark upon all the main Branches of his Reasoning, that the World may see what sort of Arguments those are, with which they have been so long deceived.

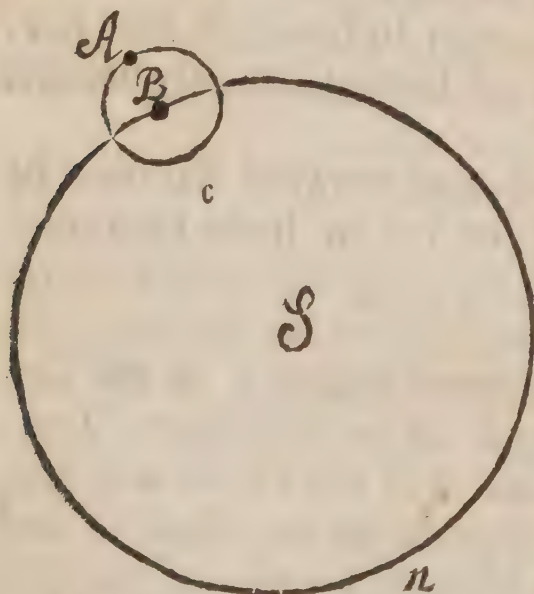
The next Branch of his Reasoning upon this Subject, is his Proof, That in the Case of a Body, round which another revolves, being in Motion, the Body describing round it Areas proportionable to the Times, is forced into its Motion by all the Force by which that Body round which it describes those Areas

as

as is moved, and beside that by a Centripetal Force directed to that Body. This Case, as I observed before, is distinguish'd from the other by Dr. Gregory; and his Way of proposing this Argument sets it in a clearer Light. Mr. Newton proves this Point in his 2d and 3d *Pro. L. 1.* and Dr. Gregory in his 20th *Pro. L. 1.* The Sum of both their Arguments is,

If equal and parallel Motion be destroyed or taken from two moving Bodies, they will move in respect of each other as before: So that if *B* move round *S* in the Orbit *Bn*, and *A* at the same Time move round *B* in the Orbit *Ac*, subtracting from *B* all its Motion, and from *A* a Motion equal and parallel to all *B*'s Motion, then will *A* continue to describe round *B* the Orbit *Ac* as before; but if in describing *Ac*, it describe round *B* at rest Areas proportionable to the Times; by the Proof of the former Case, the Force by which it is moved is di-

rected to *B*; but its Motion consisted at first of what was destroyed, and what remains. And what was destroyed being a Motion equal and parallel to all *B*'s Motion, was produced by all the Force that produc'd *B*'s Motion; Effects being proportionable to their Causes. So that



all the Force by which *A* moves, is all the Force by which *B* moves, and a Force directed to *B*.

I have nothing to say against this Demonstration, as depending upon the former; my Design being only in every Argument to observe what Fault is peculiar to it: So that in considering this and all other of our Authors Arguments, I shall still suppose

suppose all former Propositions fairly demonstrated. This being premised, the Fault of this Demonstration, which I shall first observe, is much of the same kind with the first I observed in the former, *viz.* It is positively affirmed of *A* that its Motion is produced by the Force that produces *B*'s Motion, and by a Force directed to *B*, and only proved that *A*'s Motion might possibly be produced by such Forces.

It is plain that the real Motion supposed to be performed by *A*, may be supposed divided into two Motions different from these two in which it is supposed divided, *viz.* different from the Motion of *B*, and a Motion round *B*, as well as it may be supposed divided into those Motions. And then by our Author's Reasoning, the Causes of these two different Motions must be proportionable to the Effects, and consequently different from the Causes assign'd; and since there are infinite Numbers of possible Divisions of any Motion,
so

so are there infinite Numbers of different Causes, which by this Way of Reasoning may be proved to be the Causes of this or any other Motion. So that all that is here proved, and all that ought to have been here asserted, is, that the Motion in Question may be accounted for from the given Causes ; and then, as I observed before, if there had not appear'd some Inconvenience in admitting that to be the Cause, this Argument might have been of Use in Physicks : But the chief Thing here to be observed is, that there is an Inconvenience in admitting this Cause to be the Cause of that Motion ; so great and so evident, that it could not possibly have been overlook'd, if Men's Inquiry after the Inconveniences of admitting this Cause had not been laid asleep by the shew of a positive Demonstration, that this is the Cause of the given Motion ; nay the Inconvenience in admitting it to be so, is so extreamly obvious, that there was

a Necessity for using another Art to conceal it, *viz.* not so much as to mention one part of this Cause, the very Name of which would have discovered the Absurdity.

For making all this appear, let us consider that the Cause of *B*'s Motion round *S*, which is the one part of *A*'s Motion, is according to the Proof of Case 1st, a Force by which the Body, by the Nature of Bodies in Motion, endeavours to run out in all the Tangents of the Curve *Bn*, and a Centripetal Force directed to *S*. The other Part into which *A*'s Motion is divided, *viz.* a Motion in the Curve *Ac* round *B* at Rest, by the Proof of Case first, is produced by a Force with which the Body endeavours to run out in all the Tangents of the Curve *Ac*, and a Centripetal Force directed to *B*. Now both our Authors take very good Care not to mention in this Place that half of their Cause, which consists in the Endeavour of the Body to run out in Tangents; which
if

if they had not done, the Absurdity of supposing the Cause of any Body's Motion to be an Endeavour in the Body at every Instant of time to run out in two different Lines, (as the Tangents of those two different Curves are) at the same Time, is so very gross and evident, that it could never have been swallowed by any Man of common Sense.

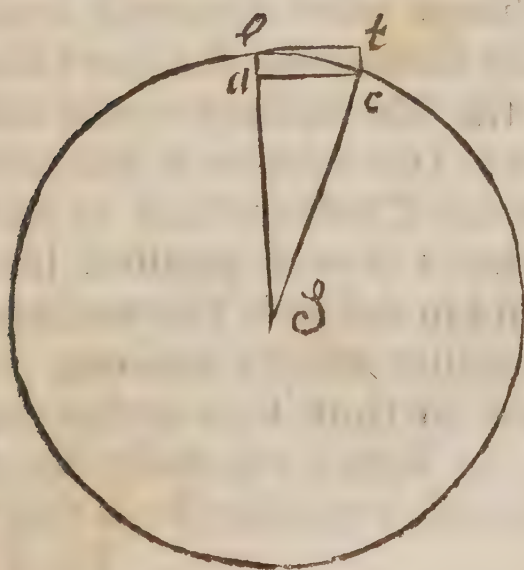
From this, it's plain, I might draw a Mathematical Demonstration, *a priori*, independent of the former Demonstration, proving that *Satellites* in particular are not moved by a Centripetal Force; but the former Demonstration does this so clearly, that any more Proofs were absolutely needless; and beside, my Design in this Place is only to observe the chief Faults of the main Branches of the Reasoning that supports Mr. *Newton's* Philosophy.

Mr. *Newton*, *Pro. 4. L. 3.* affirms, That the Force by which the Moon is hinder'd from running out in streight Lines and kept in her Orbit,

Orbit, is the same with that Force by which heavy Things fall to the Ground ; and Dr. Gregory, in his 46th *Prop. L.* 1. asserts the same, and their Demonstrations are alike, *viz.*

The Moon's middle Distance is 60 Semidiameters of the Earth by Calculation ; it appears also by Calculation, that she describes in a Minute the Arch lc , whose Versè Sine la is $15\frac{1}{2}$ Feet; so that in describing that Arch, or in a Minute she falls from her Tangent lt the Space $tc = la$, that is $15\frac{1}{2}$ Feet. Now the Force which makes the Moon fall from her Tangents being in different

Distances, as the Squares of those Distances would force her if upon the Surface, or at the Distance of 1 Se-



1 Semidiameter to move in a Minute a Space which is to $15\frac{1}{2}$ Feet as the Square of 60 to the Square of 1, viz. $60 \times 60 \times 15\frac{1}{2}$ Feet in a Minute; but it is found by exact Experiment that heavy Things with us, at the Distance of 1 Semidiameter, fall $15\frac{1}{2}$ Feet in a Second; and it's well known that they accelerate their Motion in falling in a Duplicate Ratio of the Time of falling: So that in a Minute, or 60 Seconds, they must fall $60 \times 60 \times 15\frac{1}{2}$ Feet, the very same Space the Moon would fall at the same Distance. And by inverting the same Computation, if heavy Things were removed from the Earth's Center to the same Distance as the Moon, they would fall as she does $15\frac{1}{2}$ Feet in a Minute. So that these Causes which in like Circumstances would produce like Effects, and in different Circumstances do produce Effects differing in Proportion to those Circumstances, must be the same; especially since both Forces that produce both these

Effects

Effects are directed to the same Center.

Mr. *Newton* adds another Reason in the latter End of his Demonstration, *viz.* That the Cause which turns the Moon from her Tangents must be the same with that Cause which forces heavy Things toward the Center ; because if those Causes were different, both together would force Bodies to fall $30\frac{1}{2}$ Feet in a Second contrary to Experience. But this Reason Dr. *Gregory* very judiciously omits ; and it's strange that so plain a *petitio principij* should have escaped Mr. *Newton's* Pen ! As for the other Part of this Proof, the chief Fault of it is, that our Authors compare the real Motion of the Moon not with the real Motion of falling Bodies, but with their apparent Motion only : or to speak more clearly, the whole Motion of the Moon with part of the Motion of falling Bodies ; which is liker Juggling than Reasoning : And this Fault in this Argument is of the great-

greatest Consequence, because the Nature of the Argument is, from the Likeness of Effects, to infer that those Effects are produced by the same Cause.

It appears very clearly that the real Motion of the Moon is compared with the apparent Part of the Motion of falling Bodies only, even from what Mr. *Newton* himself says; for he acknowledges that his Calculations of those Motions depend upon the Supposition of the Earth being at Rest. Now since the Earth appears to us at Rest, and we are altogether insensible of its Motion, and consequently of the Motions of Things that accompany the Earth in its Motion; it's plain that this Part of the Motion of falling Bodies which they perform in accompanying the Earth, though it be a real Motion, is to us insensible; and that Part of the Motion of a falling Body by which it differs from the Earth's Motion, is all that appears to us, and all that our Author brings into his Calculation,

tion, since he supposes the Earth to be at Rest. It's true, in calculating these Motions, there was no need of taking into the Calculation that Part of the real Motion of the Moon or of falling Bodies, by which they accompany the Earth in its Orbit; because this Motion is in the Moon, and falling Bodies perfectly equal; and whether we take this Part of their Motion into the Account or leave it out, the Difference of these Motions will be the same. So that if Mr. *Newton* had only supposed the Earth at Rest from the Motion in its Orbit, his Reasoning had been fair; but he supposes also the Earth at Rest from the turning upon its Axis; as appears by his leaving out of his Account of the Motion of a falling Body that Part of its Motion which depends upon the Earth's Diurnal Rotation; and compares only the remaining Part of the Motion of falling Bodies with the Moon's whole Motion. So that if what Mr. *New-*
ton

ton pretends to demonstrate by his Calculation be true, *viz.* that the Part of a falling Body's Motion which he considers is the full adequate Effect of such a Cause as that which turns the Moon in her Orbit; then does he fully demonstrate that a different and greater Effect cannot possibly be produced by that Cause. Now that the Effect of the Force which drives falling Bodies from running out in streight Lines, is more than what he considers, is thus evident.

The Earth by turning upon its Axis would certainly throw out all Bodies lying loose upon its Surface in Tangents; or rather those Bodies being in Motion would by the Nature of Motion necessarily run out in those streight Lines, as well as the Moon would run out in the Tangents of her Orbit, if some Force did not hinder them: And if Gravitation were a Force that did no more than hinder Bodies from running out in Tangents, then it might in my Opinion be very reasonably

sonably thought to be the same with that Cause which hinders the Moon from running out in Tangents. But since Gravitation not only forces heavy Things to fall so far from their Tangents as to keep into a revolving Orbit, but likewise forces them to endeavour always to run within this Orbit toward the Center in a Spiral Line; it seems very unlikely that this is that same Cause which turns the Moon and other Planets; since that Cause, whether acting near or far from that Body from which it is supposed to proceed, strictly observes this Law, never to force any Bodies upon which it acts within their revolving Orbit; which on the contrary Gravitation always does. And certainly if Likeness of Effects be a Proof that they proceed from the same Cause, their Unlikeness is a much stronger Proof that their Causes cannot be the same; and consequently, I have much better Reason dogmatically to affirm that the Cause which turns the Moon

in

in her Orbit, and that which forces heavy Things to fall, is not the same, from having shew'd their Effects to be different, than Mr. *Newton* had to affirm them to be the same from the Likeness of Effects, though he had fairly demonstrated this Likeness. For Causes that are not the same may produce like Effects; but the same Cause cannot produce unlike Effects. But I am not fond of dogmatical Affirmations in Physicks, neither is it my Design in this Place to affirm any thing; but to examine the Reasons our Authors bring to justify their Assertions. So that I shall content my self with making appear that our Authors Demonstration, if it demonstrate any thing, demonstrates the Contradiction of that Assertion, for proving of which it is adduced.

For making of this more fully appear, let us consider that the $15\frac{1}{2}$ Feet which our Author affirms to be the Space a falling Body is forced by Gravitation to move in a Second, is that Space which it moves
upon

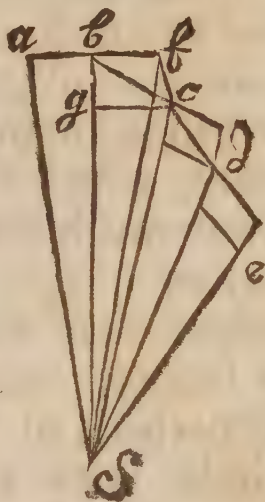
upon the Supposition of the Earth being at Rest, or that Space which it appears to us to fall in a Second: And it's also certain that beside this Space of $15\frac{1}{2}$ Feet in a Second which it appears to us to fall, it does really fall a Space in a Second equal to that Space which we and all other Things that to us appear at Rest do really fall, toward the Earth's Center, from those Tangents or streight Lines into which we must necessarily run out, if Gravitation did not hinder us and force us from these Tangents. So that, according to our Authors Way of computing, a falling Body falls in a Second a Space equal to the Verse Sine of an Arch of the Earth's Circumference of $17'' + 15\frac{1}{2}$ Feet; and if his Proof that the falling $15\frac{1}{2}$ Feet in a Second is the full Effect, that the Cause which turns the Moon in her Orbit would have if it acted upon the falling Body, certainly the falling $15\frac{1}{2}$ Feet + the Verse Sine of the said Arch, which is the real Effect

fect of Gravitation, cannot possibly be produced by that Cause; and therefore Gravity, the Cause that produces this actual Motion, must be different from that Cause that turns the Moon in her Orbit.

I cannot pass over this Point without observing another Fault in this Demonstration, *viz.* That our Authors affirm the Moon to fall from her Tangents a Space equal to the Versè Sine of any Arch in describing that Arch; that is to say, they condescend upon a certain Tangent, and conceive the Moon to be continuing to fall from that Tangent; notwithstanding that in Reality a Body moving in a Curve endeavours to run out in the Tangents of every Point of that Curve, and must by a Force acting upon them, in every Point of their Motion, be forced from these Tangents. So that in Reality it is from all possible Tangents a Body moving in a Curve falls, or is really drove by that Force which forces it to de-

describe a Curve; as appears clearly from our Authors Account of a Curve, which I have repeated above,

viz. The Body describing the Curve *abcde*, in the Points *b*, *c*, *d*, and *e*, is forced from the Tangents of every one of those Points; and in describing *bc*, falls from *bf* the Tangent of *b*, the Space *cf* = *bg*; and in performing, *cd*,



falls from the Tangent of the Point *c*, as before from the Tangent of the Point *b*; and in performing any Number of such Motions, falls from that Number of Points the same Number of such Spaces. If this be deny'd, and if it be asserted that a Body moving in an Orbit continues to fall from one Tangent, I ask, where is that Tangent from which it falls? Or how comes it, when it has described a Semicircle, to leave

off falling and begin to rise to that Tangent again? Since in the Sense it can at any time be said to fall from its Tangents, it can always be said to fall from them. At this rate some part of the Orbit must be condescended upon to be the uppermost Place, which I believe our Authors are so much Philosophers as not to do; or if they would, then will it follow that the Moon accelerates in falling, even upon our Authors Hypothesis of her Motion being a Circle with equal Velocity, *viz.* that the Velocity of her falling Motion encreases in a Proportion to the Times of falling, as the Versè Sines of Arches to their Arches. And it is very strange, if any part of a Motion so uniform and equable as the Motion in a Circle with equable Velocity, should be so variable and accelerate in such Proportion; but much more strange that after completing 90 Degrees of this Circle, the Increase of Velocity should begin to abate. Beside, if all this be
true,

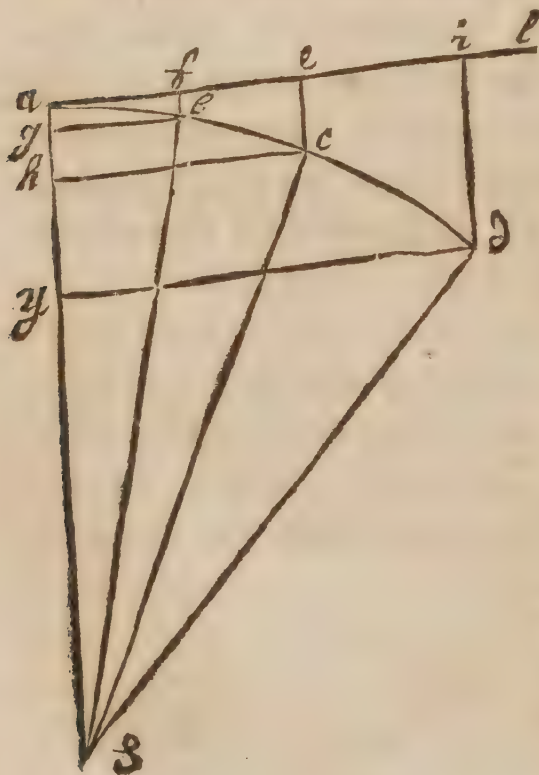
true, then it is not true that in any Minute of the Moon's periodical Time, she falls $15\frac{1}{2}$ Feet; for at this rate she only falls just so much the first Minute she begins to fall from the Tangent of her highest Point, and in that Minute before she come to her lowest Point; and in all other Minutes in that Part of her Orbit where she falls, she falls more then $15\frac{1}{2}$ Feet.

But it is needless to insist upon the Absurdities of supposing the Moon to continue any assignable Time falling from any assignable Tangent; or to show that she really falls from every Tangent. This Matter being very evident, I shall next show what is the Space which the Moon may be really said to fall from her Tangents in any Time; which will appear from the following *Theorem*.

THEOREM II.

A Body describing any Arch ad , really falls from the Tangent of every Point of that Arch a certain Space, and the Sum of all those Spaces is, in Respect of the Verse Sine of ad , infinitely little.

Suppose ad divided into equal



Parts ac and cd ; suppose also the Force turning the Body into this Curve to act in the Points a and c , the Force acting in a , forces the Body to fall

fall from the Tangent of the Point a , the Space ec ; and another Force equal to the former acting at c , forces the Body from the Tangent of the Point c a Space equal to ec . So that if the Arch ad be supposed performed by two Pushes of a Force acting in two Points a and c , the Space the Body will fall by these Pushes, *viz.* $2ec$ is not so great as the Space id , which it would have fallen from the Tangent al , if it had been forced to describe ad by the Force ay : Or which is all one, the Force ab , twice repeated at the Points a and c , that is, $2ab$ is less than ay . And if again we suppose the Arch ac , produced by two Forces acting in the Points a and b , the Sum of these two Forces or the Sum of their Effects, *viz.* the Spaces which they force the Body to fall from the Tangents of the Points a and b , are less than the Force ab , or the Space ec : Therefore if the Arch $abcd$, be supposed produced by three Forces acting in the Points a , b , and c , the

Sum of these three Forces or the Sum of their Effects, *viz.* the Spaces they force the Body to fall from these three Tangents, is less than when this Arch was supposed to be produced by two; and so the more Points the Force be supposed to act in, the less is the Sum of those Forces or the Sum of the Spaces which they force the Body to fall from its Tangents, if compared with *ay* or *id*. And since it appears plainly both from our Authors Way of accounting for a Curve from a continuing Force, and from what I have already said, that a Body moving in a Curve really endeavours to run out in streight Lines at every Point, that is, at an infinite Number of Points; and the continuing Force really acts in all these Points, and at every Point forces the Body from the Tangent of that Point; and since I have now shewn that the Sum of the Spaces, which a Body forced from Tangents by a Force acting in different Points falls from those

those Tangents, diminishes as the Number of Points in which this Force is supposed to act increases. The Sum of the Spaces, which this Force that acts in one infinite Number of Points forces the Body to fall from all its Tangents in describing the Arch ad , is to the Space id , or its Equal ay , infinitely little.

C O R O L L A R Y.

Hence it appears that all Estimates of the Quantity of a Force turning a Body from streight Lines into a Curve, if they measure the Force that produces any assignable Arch by the Verse Sine of that Arch, or compare the Forces that produce any two Arches, one whereof is greater than the other, by the Verse Sines of those Arches, are erroneous.

Mr. *Newton*, in his 5th Prop. L. 3. and Dr. *Gregory*, in his 47th Prop. L. 1. assert that the Cause

which keeps all the Planets, both Primary and Secondary, in their Orbits, is the same with the Cause that keeps the Moon in her Orbit, *viz.* Gravitation: And though I am inclined to think the Cause that keeps the Primary Planets in their Orbits round the Sun, to be somewhat different from that which keeps Secondary Planets in their Orbits round their Primaries; yet I do not see any so great Fault peculiar to this Proposition as to have mentioned it, were it not that both our Authors draw from it a very important Corollary, which will by no means follow. This Corollary is, That since the Secondary Planets gravitate upon their Primaries, and the Primary Planets upon the Sun, Action and Re-action being mutual, the Primary Planets must also gravitate upon their Satellites, and the Sun upon the Primary Planets.

In drawing this Corollary, it's evident that our Authors suppose their Gravitation to be the Action
of

of those Bodies to which that Force is directed; for proving of which, they offer not so much as to shew one Argument, but suppose it only; and therefore no more is requisite for overturning this *gratis dictum*, but to deny this Force to be the Action of those Bodies to which it is directed, or at least to deny that it appears to be so.

But that I may not here be thought to deny a Thing that is very probable, for no Reason, but because it is not prov'd: I shall show that what is supposed in this Corollary, is not only improbable, but inconsistent with all those Laws of Nature that have ever been discovered by any Man beside Mr. *Newton* and his Followers. In order to which, let us distinguish betwixt the mediate and immediate Action of Bodies. The first is, when the Action of one Body is communicated to another by some intermediate Agent; as when I throw a Stone against the Wall, I act upon the Wall by the Means of
C 5 the

the Stone. The second is, when one Body, without the Intervention of any other Being to assist it, acts it self upon another Body ; and in this Sense it never did appear that Bodies could act upon one another other-ways than by Touch ; and it is from the Nature of Touch, which cannot but be equal and mutual, that this sort of Action, which can only be properly called the Action of Bodies, is necessarily mutual. The first kind of Action is not properly Action ; but only a Way of speaking accommodated to the Ways of thinking of the Vulgar : For when a Man throws a Stone against the Wall, his Hand acts upon the Stone, and not upon the Wall ; and the Stone acts upon the Wall. Just so a Horse that pulls a Stone, which is fastned to him by a Rope, only pulls or acts upon the Rope ; and it depends upon the Nature and strong Cohesion of the Rope, that it is fit to communicate this Action to the Stone. When Bodies act immediately upon each other by Touch,
then

then is Reaction equal and of a contrary Direction by a Physical Necessity ; but when Bodies act mediately upon each other, then is Action and Reaction mutual or not mutual, according to the Nature of that which conveys the Action of one Body to the other ; as the two foregoing Instances sufficiently show : For if a Horse is fastened to a Stone by a Rope, and this Rope be strong enough and no other Thing hinder, this Rope will communicate to the Stone the Action of the Horse, and the same Rope will communicate to the Horse the Reaction of the Stone : But then, in the other Instance of a Man throwing a Stone against the Wall, there is no Necessity in Nature that the Wall should throw another Stone at him again. Now since Mr. *Newton* says that his Cause proceeds from Bodies, and penetrates other Bodies ; and since it is not to be supposed that he means to assert that Bodies proceed from themselves and penetrate each other,

we

we may safely conclude that his Cause, or that whatever it be that thus penetrates, acts, and impresses upon Bodies this Force directed to each other, is a Being different from the Bodies themselves ; and if so, all the Reaction that is in this Case necessary, is that the Bodies which are acted upon by this Instrument of Attraction, must react upon that Instrument, provided the Author of it will suppose it to be such a Being as can be reacted upon by Bodies. This Instrument may also be supposed fit to communicate to that Body from whence it proceeds this Reaction of those Bodies that react upon it. But then it is plain that this would not be Proof, which our Author pretends, but Hypothesis only ; and such an Hypothesis would be pressed with many and great Difficulties, which it is not my Business here to show. All I am concerned to do, is what I have already done, *viz.* to make appear that our Author's Reasons do not prove his Assertions.

It's

It's strange he did not rather chuse to prove the Mutualness of Attraction in the Stars from the Likeness of the Nature of those Bodies, than from the general Law of Action and Reaction; since it is from this Likeness, and not from the Law of Action and Reaction, that all natural Attractions which are mutual do proceed. For Instance: The Attraction of two Loadstones; the Actions as well as Reactions of which Bodies appear to depend upon something particular in their own Nature, different from that Part of their Nature common to them and all other Bodies, by which they act and react upon any Body whatever. And two Stars being as like, and to be supposed of one Nature as much as two Loadstones; since our Author proves one of them to attract the other, or to send forth something that penetrates its Substance, and pushes that other toward it; why might not he from the Likeness of the Nature of those Bodies infer, that
this

this other Body would send forth some such Thing to attract it? This Way of Reasoning would have carry'd in it some Probability, and consequently might very well have been used in Natural Philosophy.

But our Author makes use of no probable Reasonings; he had a Mind to secure his Philosophy from all Cavils and Disputes, by asserting nothing without full and absolute Demonstration, or at least not without something dressed up like such, as he himself tells us * in his Introduction to his third Book; which contains his Philosophy. He foresaw in general, that his Philosophy would be called in Question, and objected against, if without that Security; and to this particular probable Argument, if he had used it, many Objections might have been

* *Ne res in Disputationes trahatur Summam Libri; transtuli in propositiones more Mathematico.*

made, *viz.* Though in the Case of the Attraction of the Loadstone and some others, Attraction may appear to be mutual; yet in some Attractions this does not appear. It might also have been universally denied of all Attractions, that the Force, or that which impresses the Force, appears to proceed from those Bodies to which this Force is directed, which are said to perform this Attraction in the common Way of speaking; and this can never be proved. Nay, an Attraction, as properly so called as any other, may be instanced, in which it appears that the Force, or that which impresses the Force, proceeds not from that which is said to attract, and the Attraction appears also not to be mutual, *viz.* that Attraction by which a Void draws or sucks into it Air, Water, &c. And yet, this same Attraction, which is of so very different a Nature from our Author's, may by as good Argument as the Nature of the Subject will allow be proved very like
like

like some part of that Force which hinders the Primary Planets from running out in Tangents. But to do this, is not proper in this Place. And whether this can be done or not, still from what has been said it appears, that if our Author had used the probable Argument I mention'd, or if any Man think fit to use it in his Behalf, yet there might have been more Objections made against it, than would have ballenc'd its Probability ; but however, if he had used that Argument, it would still have had some Weight, whereas what he urges can be of no manner of Use.

Mr. *Newton* draws another Corollary from his 5th Prop. and the Corollary I spoke of, *viz.* That all the Planets gravitate upon each other ; and infers from this, that when near one another, they must necessarily disturb each others Motions, as some of them appear to do. But this Disturbance that appears, if rightly consider'd, will appear liker the Effect

fect of a Power in those Bodies mutually to drive away, than mutually to attract each other. But this I leave to Astronomers. As for the Corollary itself, I cannot see how it follows from the Proposition or former Corollary; and our Author says nothing to show the Connexion of this Corollary with any of them, nor gives any Reason for his drawing such a Corollary: Neither can I find any Reason he had for so doing, but to honour his own Invention, and dignify his Cause with the Title of *Catholick* and *Universal*, which appears from his 6th and 7th Prop. which depend upon this Corollary, wherein he asserts universally of all Bodies whatever that they attract each other.

He asserts also in these Propositions, That the Force of his Attraction acting upon different Bodies which are at the same Distance from the attracting Body, is as the Quantity of Matter which those Bodies contain: His Proof of which is to this Purpose. It

It appears universally in all Bodies that gravitate upon any other Body, that whatever their Bigness or Quantity of Matter be when at like Distances from the attracting Body, they fall equal Spaces toward it in equal Times, or fall to it with equal Velocity, and the Force that accelerates Bodies of different Quantities of Matter equally, being as their Quantity of Matter; This Force, which thus accelerates Bodies of unequal Quantity of Matter equally, must be as the Quantities of those Bodies. Moreover, all the Parts of those Bodies must necessarily attract with a Force proportionable to their Quantity; for if any Sort of Parts in a Planet attracted more or less than in Proportion to their Quantity, the whole Planet would attract more or less than according to its Quantity, as it most abounded of the one or other Sort of these Parts.

This Proof has so many, so great, and so evident Defects, that it scarce deserves

deserves the Name. Some of the most obvious of them, I shall mention; and enlarge upon that only, which to me seems most considerable.

It's plain then, in the first Place, that the Question is here begg'd, and the Attraction of a Planet supposed to be made up of the Attractions of its Parts; for though it may be thought that the Earth attracts its Parts, because they fall to it, yet I challenge any to show from any Appearance that those Parts attract any Body in Nature, or any ways produce upon them any sensible Effect which may be attributed to their Attraction.

It's here also supposed, that Planets of unequal Quantity of Matter gravitate equally; when only the Difference of Bulk and not Quantity appears, which are very different.

But the chief Fault of this Argument is, that it depends upon this Assertion, that Forces which produce

duce a Motion of equal Velocity in Bodies of unequal Quantity are as the Quantities of those Bodies; which is apparently false, and as far as I can see, has not the least Shew of Truth; For Instance, Two Ships of unequal Bigness and Quantity, carried by the Stream of a River, are brought into a Motion of equal Velocity, by the Force of the Pressure of the Water: And certainly the Force of any Quantity of Water that presses upon the one Ship, is equal to the Force of an equal Quantity of the Water that presses upon the other; and consequently, the Force of all the Water that presses upon the one Ship, is to the Force of all the Water that presses upon the other, as that Part of their Surfaces upon which the Water presses, which in Ships of different Quantity might be made equal; nay, the Quantity of that Part of the Surface upon which the Current presses might be made greater in the small Ship than in the big one: Or, if our Author
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does not mean the Quantity of Force, but its Velocity, or *Vis Acceleratrix*, as he calls it, then is this precisely equal in our Instance, for the Water presses the great Ship and small with a Force of equal Velocity.

There may be innumerable Instances of this kind; such as the same Wind which drives unequal Clouds with equal Velocity. A Body of 100 Pound Weight, in a Motion of any given Velocity, striking upon a Body of 10 Pound, and upon another of 50 Pound, will bring these unequal Bodies into a Motion of equal Velocity, though it acts upon their Surfaces only, and that with a Force the same, both in Quantity and Velocity, *viz.* All the Force and Velocity with which it self moves, for it can give no more Velocity to the smallest than it has, and it will be able to put the greatest into a Motion of a Velocity equal to that in which it self moves.

But

But what need we spend Time in giving Instances of this, since all Bodies of unequal Quantity of Matter moving with equal Velocity, (where it appears by what Force they are moved) appear to be moved by Causes that act upon their Surfaces only; and almost all those Bodies appear also to be moved by Forces which are either equal or not in Proportion to the Quantities of those Bodies. So that I protest I cannot see what has drawn our Author into such a Mistake, as to infer from the equal Velocity of the Motions of Bodies differing in Quantity, that those Motions must be produced by Forces proportionable to these different Quantities; and again from that to infer that this Force must act upon the whole Substance of Bodies. Nor can I see how it comes that ever any Man of good Sense could think that these Inferences were fair, or be induced by this Argument to frame an Idea so very strange, as that of a Cause penetrating

netrating and acting, not upon the Surface, but upon the whole Substance of Bodies. But to proceed,

Both our Authors assert in some of those Propositions which I have considered, that the Force which turns the Stars in their Orbits, in different Distances from those Bodies round which these Orbits are described, is as the Squares of those Distances. And this Part of these Propositions I have not taken Notice of, because I cannot say but the Cause which turns the Stars in their Orbits may be such; nay, I am inclined to believe it to be such. And therefore though the Arguments our Authors use to prove this be very weak, yet it were criticizing upon those Authors (which I have no Mind to do) rather than handling my Subject, to remark upon those Arguments.

That which concerns my Subject in this Point, is their Assertion, that Attraction is such a Force as at different Distances is as the Squares

Squares of those Distances; because the Proof of this Assertion proves their Cause to be in that Respect like the true Cause, and so yields some Probability of its being the true Cause.

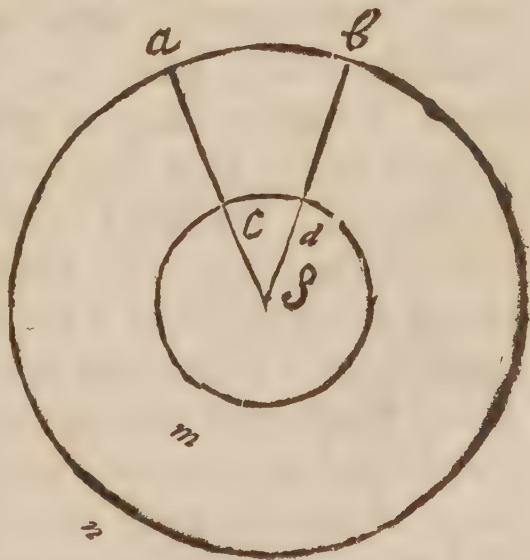
This Point Mr. *Newton* no where proves; but asserts or supposes only; but Dr. *Gregory* proves it Prop. 48. This Proposition asserts,

That the Force or Efficacy of any Virtue (such as Attraction) which spreads it self either to or from a Center in streight Lines, through all the Space that surrounds that Center, must in different Distances from the Center be as the Squares of those Distances. His Demonstration is,

It's plain that any Quantity of this Virtue being scatter'd equally through a greater Space, and the same Quantity being scatter'd equally through a lesser Space, there will be of this Virtue in any given Part of the greater Space a Quantity, which is to the Quantity of it that
is

is in an equal Part of the lesser Space, as the lesser Space to the greater. It's plain also, that the Force or Efficacy of this Virtue in any two Places, is as the Quantity of it that is in those Places. Let S be the Center; describe round S the two Spherical Surfaces abn and cdm ; draw the Lines aS and bS . The same Quantity of this Virtue that is spread through the Spherical Surface cdm , is also spread thro' the Spherical Surface abn ; therefore in any Part of the Surface

cdm , the Force of this Virtue is to its Force in an equal Part of abn , as abn to cdm ; but



abn is to cdm , as the Squares of the Circles abn to cdm ; which are

D

as

as the Squares of the Radij aS and rS : viz. The Distances of the Surfaces $c d m$ and $a b n$.

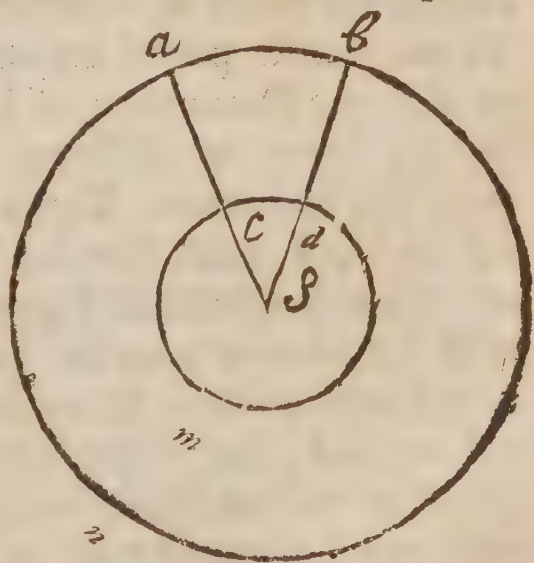
For my part, I believe this Proposition to be both very true and very fairly demonstrated of all Virtues that act upon Bodies, and proceed to or from a Center in streight Lines; but then, I believe this, only because I also believe that no such Virtue can act upon any more than the Surfaces of Bodies, and that the Cause which forces the Planets into Curves, acts upon their Surfaces only, and that its acting upon Surfaces only is the Reason why it keeps this Proportion to the Distances. Whereas our Authors Attraction being, as both of them many times assert, a Virtue that proceeds from a Center in streight Lines every Way, and acts upon the whole Substance of Bodies, or their trine Dimension; it must be in different Distances, as the Cubes of those Distances, which I shall demonstrate in the following *Theorem*.

T H E-

THEOREM III.

The Force or Efficacy of any Virtue, which spreads it self in streight Lines through all the surrounding Space equally to or from a Center, and acts upon the whole solid Content or trine Dimension of Bodies, must in different Distances from that Center be as the Cubes of those Distances.

Suppose the Virtue that is spread to or from the Center *S*, to act upon Lines or the one Dimension only, viz. the Circles *c d m* and *a b n*:



Since this Virtue comes in streight
D 2 Lines,

Lines, it's plain that the same Quantity of it which falls upon the Line ab , will also fall upon the Line cd ; because those Arches are intercepted by the same streight Lines aS and bS : And therefore the Force or Efficacy of this Virtue, acting upon equal Parts of those Lines, by our Authors Demonstration, will be as the Lines which are the Spaces in which the Virtue is supposed to be spread; but these Lines cd and ab are as the Radij cS and aS , or their Distances from S . So that if this Virtue be supposed to act on Lines or the one Dimension of Length only, its Force in different Distances is as the Distances. Upon the Lines cd and ab erect Similar Triangles, or other Superficial Figures; they will be to one another in a Duplicate Ratio of their Homologus Sides cd and ab ; but if the Virtue is supposed to act on these Surfaces, there will equal Quantity of it be spread in those Similar Superficial Figures, and consequently upon equal Parts of
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those Surfaces the Force of that Virtue will be in a Duplicate Ratio of cd and ab , which are as the Distances of those Surfaces from S : (as our Author in his Prop. demonstrates.) Upon those Superficial Figures, erect Similar Cubical Figures, they will be in a Triplicate Ratio of cd and ab ; and consequently if the Virtue be supposed to act in a Cubical Space, or upon the three Dimensions of Length, Breadth and Thickness, its Force must at different Distances be as the Cubes of those Distances. *Q. E. D.*

C O R O L L A R Y.

Hence it appears that Attraction, which acts upon the whole Substance or trine Dimension of Bodies, can neither be the Cause that turns the Stars in their Orbits, nor the Cause that forces heavy Things to fall to the Ground; nor of any Centripetal Force, which in different

Distances is as the Squares of those Distances.

Mr. *Newton*, in his 10th Prop. asserts, that the Planets may keep their Motions exceeding long without Diminution; which he thus proves.

The Air as it rises from the Earth's Surface rarifies in a great Proportion; so that as high as the Planetary Regions it must become exceeding thin; and the Resistance of a Fluid being as its Density, the Resistance of that Fluid, which in those Regions is so exceeding thin, becomes almost nothing.

This Proof is extremely weak, for though it be granted that the Density of our Atmosphere decreases in any Proportion Mr. *Newton* pleases to assert; yet neither he, nor any Body else that I know of, asserts that this Atmosphere reaches thro' the Planetary Regions, or that the Planets move in our Atmosphere; but that they have Atmospheres of their own, and that those Atmospheres

spheres are a Part of themselves, that move along with them; as we are sensible that our Atmosphere moves along with our Earth: But what is the Nature of our Atmosphere, or the Proportion betwixt the Density of its Parts to the Fluid (if any be) that fills the Planetary Regions thro' which our Atmosphere moves? Nay, is it not taken for granted by Mr. *Newton* and his Followers, from the Refraction of the Rays of Light, when falling on our Atmosphere, that the Fluid of which it is composed is different from that Fluid that fills the Planetary Regions? And if so, What does the Density, or Proportion of Density of the one Fluid relate to the Density of the other?

Dr. *Gregory* is so sensible of the Weakness of this Demonstration, that in this Point he forsakes his Guide, and demonstrates this Proposition, after a manner quite different, in his 44th Prop. L. 1. He is also somewhat more bold in assert-

ing; for he affirms the Planets to be in their Motions altogether free of Resistance, and that therefore their Motions may continue undiminished. His Proof of this Assertion, is this:

The Orbits of the Planets appear to continue the same; but if those Bodies met with any Resistance at all, this Resistance, continuing to act upon them in many Revolutions, could not but produce a sensible Effect, * and make their Orbits far different from those Eliptick Orbits, in which they appear to move; these being the Figures they are demonstrated to describe, if no Ways resisted.

This Proof is thus far preferable to Mr. Newton's, That it follows fairly enough from what they imagine to be proved before, viz. That

* *Si foret vel minima resistantia &c. Planetarum via Saltem in Pluribus revolutionibus, immane quantum ab Elipsibus discrepare deprehenderentur &c. Nulla est ergo &c.*

a Centripetal Force turns those Bodies into Eliptick Orbits ; for if the Effect of that Force alone be to turn a Body from a streight Line into an Eliptick Orbit, any other Force also acting upon this Body must necessarily have its full Effect, and in Composition with the former, produce a Motion different from what the former alone would do. And its also evident that this other Force, if it be at all, is not to be supposed so small as not to produce a sensible Effect, when continuing for any considerable Time.

Since this Demonstration is fairly drawn from what is before, I should not have mentioned it, but that it is a very strong Proof of the Absurdity of our Authors Hypothesis : For though it be fair Reasoning, it gives a much greater Proof of the Absurdity of that Hypothesis, than the weak Argument with which Mr. *Newton* supports his Hypothesis in this Point. For to draw an Absurdity by fair Reasoning from

an Hypothesis, is to demonstrate that Hypothesis to be absurd; whereas to support an Hypothesis by weak Arguments, is only to make it probable that the Hypothesis is false.

The Absurdity that Dr. *Gregory* here demonstrates from his Hypothesis is very evident; for if the Planets be absolutely free of all Resistance in their Motions, then either the Spaces through which they move, are absolute Voids; or the Bodies with which those Regions are filled, do not react upon the Planets when they force their Passage through those Regions. That the Planetary Regions are absolute Voids, is what I think no Man ever ventured to assert, and what I shall have Occasion hereafter to demonstrate to be absurd. And I suppose no Man will deny the Absurdity of believing that the Bodies (if any be) which fill the Planetary Regions, do not react upon the Planets, when acted upon by the Planets,

nets, and the Planets must necessarily act upon them to force their Way.

Mr. *Newton* himself seems to have been well aware of this Difficulty; for he appears not so much streightened in any Point as in this, which we may easily see by the extravagant Accounts he makes up of the Thinness of that *Ætherial* Fluid, which fills the Planetary Regions, drawn from the Hypothesis of a Diminution of Density in the Fluid that lies betwixt the Surface of the Earth and the Planets, continuing in the same Chain of Proportion, that begins near the Surface of the Earth in our Atmosphere; and that the whole Column of this Fluid is equal in Quantity to a Column of Water 33 Foot high: Which two Hypotheses he represents as certain; and from them * calculates that the Density of this Fluid, at the Di-

* *Prop. 41. L. 1.*

stance

stance of one of the Earth's Semidiameters from the Surface is so small, that as much Fluid of that Density as would fill a Sphere as wide as the Orbit of *Saturn*, would not contain so much Matter, as the Quantity of Matter contained in so much of our Air upon the Surface as is comprehended within a Spherical Space of an Inch Diameter. And if this be true, this Fluid at the Distance of so many Semidiameters as the Planets are removed from us, will be so thin, that no Resistance that is sensible could have been expected from it in a much longer Time than since the Creation of the World. And to say truth, I think Mr. *Newton's* Way of acknowledging the Planets to be resisted in their Motions, is as reconcileable with their continuing to describe the same Orbits without any Diminution of their Motion, as Dr. *Gregory's* Way of denying that Resistance. And therefore I think the Shift he elsewhere makes was needless ;
where

where he tells us that the Motions of the Planets are really somewhat diminish'd, as he says a late Astronomer has found out, by comparing the Calculations of their periodical Times now, with those of the ancient *Babylonian* Astronomers. He might as well have said that the Planets (at least the Earth) have somewhat increas'd their Motion, from comparing the Calculation of the Astronomers in Pope *Gregory's* Time, with the Calculations of those in *Julius Cæsar's* Time.

It's strange that the one of our Authors should demonstrate an Absurdity from their Hypothesis, and the other have Recourse to such strange Shifts, for reconciling it with the Continuance of the same Quantity of Motion which is observed in the Planets; since their Hypothesis will account for nothing so well, as for a Supply of Motion to ballance Resistance and keep up the Stock. Certainly it is not the Fault of that Hypothesis, that according

according to it there must be a Diminution of the Motion of the Planets; for if our Authors could but account for the Direction in which the Planets move from their Cause, and keep them from gathering together in a Cluster, (which they must certainly do, if constantly attracting each other) I should help them out of this Difficulty, and show from their Hypothesis a plentiful Supply of Motion, for keeping up the Stock against Resistance.

If we suppose the Planets to move in Circles, then is the Force of Attraction in the Direction of the Radius, and the Force with which the Body endeavours to run out in the Direction of the Tangent of those Circles. But the Tangent and Radius of a Circle are always at Right Angles; and a Body moved by two Forces meeting at Right Angles, must move with a greater Velocity than the Velocity of any of those Forces: So that the one of those Forces, *viz.* the Force with which
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the Body endeavours to run out in Tangents, being equal in Velocity to the Velocity in which the Body moved the Instant before; and less than the Velocity in which it is forced by these two Forces to move the next Instant, *viz.* as the Side of a right-angled Parallelogram to its Diagonal. A Body moved by two such Forces must accelerate its Motion every Instant or continually; so that its Motion in any Instant must be to its Motion the Instant before, as the Diagonal of a right-angled Parallelogram to one of its Sides.

If the Orbits of the Planets be conceived to be Ellipses and not Circles, the Increase of Motion will be the same: For though all the Tangents of an Ellipse are not at Right Angles with the Radij, drawn to one of the Foci, yet there are as many of them at less than Right Angles with those Radij, as there are at more than Right Angles; and those that are at less, are at just as much less than Right Angles, as those

those that are at more, are at more than Right Angles with the Radij, drawn to that Focus. So that whatever less Increase of Motion there is in one Part of the Elipsis, than there would be if it were a Circle, there is as much greater Increase in another Part of that Elipsis: So that if the Sum of the Increase of Motion of a Body moving by such Forces, in its performing one full Revolution in an Eliptick and in a Circular Orbit, be compared, they will be found exactly equal.

Here is a plentiful Supply of Motion from our Authors Cause, so that they need not have Recourse to such hard Shifts as they make use of to palliate this Matter; nay, if this Increase be duly consider'd, I am afraid it will rather be more than our Authors will have Occasion for, and put them upon as hard Shifts to find Resistance enough for the Planets, as now they are to clear them of Resistance. So that I can hardly tell whether they had not as
good

good be without this Discovery ; especially considering that the Resistance of a Fluid that would then be necessary would, according to our Authors themselves, force the Planets into Spiral Lines ; and this would make the Remedy worse than the Disease ; so that they had better be without this Increase of Motion, which I have found out for them. But how can they be without it ? For nothing is more certain than that the Motion of a Body moving in an Elipsis by one Force in the Direction of all the Tangents of that Elipsis, and another in the Direction of all the Radij, drawn to one of the Foci of that Elipsis, must be encreased, if something do not destroy this Motion, as fast as these Forces meeting in that manner will increase it. So that it's absolutely necessary for those, who believe the Planets to move in Elip-tick Orbits by a Centripetal Force, to find out something to check this exuberant Motion ; and for my part, I
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can see nothing so fit for this Use as the solid Spheres of the Ancients : For those would hinder the Stars from moving in Spiral Lines, and running together ; which, as I have already demonstrated they must do, if moved by our Authors Centripetal Force ; and in hindring them from running into Spiral Lines, would check the Exuberance of their Motion, and keep them all in good Order. In short, I see nothing so fit to be joyned with our Authors Hypothesis, as that of solid Spheres ; and sure I am, those Hypotheses are in some Respect not unfitly coupled together.

There are some very considerable Objections that may be made against our Author's Account of the Cause of the heavenly Motion which he foresees ; one of which he obviates with abundance of Art in his 11th Prop. The Objection is, that if the Sun and Planets mutually attract each other, then must the Sun be moved by the Attraction of the Planets,

nets, as well as they by the Attraction of the Sun: But it is agreed upon by all Philosophers, that the Center of our System is fix'd, and now no Man of Learning questions that the Sun is this Center.

Our Author obviates this Objection, by assuming the Hypothesis, that the Center of the System of the Universe is fix'd, which he knows no Man will deny; and inferring from that Hypothesis, that the Center of our System is also fix'd. And again, from this Inference proving that the Sun is not the Center of our System; but an imaginary Point, which he calls the common Center of Gravity of all the Bodies of which our System is composed; and by this Means he takes the Liberty to fet the Sun (which according to him is not the Center of our System) in Motion, in his 12th. Prop.

The other Objections of the same Nature with this, he does not in this Place meddle with; such as that which forces him to own that
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the Earth does not perform its Orbit round the Sun, nor so much as round that imaginary Point which he will have to be the Center of our System; but that the Center of Gravity of the Earth and Moon, one imaginary Point, describes an Orbit round the Center of Gravity of our System, another imaginary Point. These Objections were not quite so evident as this he here obviates, and even this he touches very slightly; for he tells us not here what sort of Motion the Sun performs; but only extenuates the Absurdity as much as possible, by producing some extravagant Accounts of the Quantity of Matter contained in the Body of the Sun, drawn from his own Principles in his own Method. But what he says for fully obviating these Objections, he does in his first two Books, where he treats of Motions in the Abstract: For it is not so shocking to hear that *S* is supposed to move round some other Letter, as to be told in plain Terms that

that the Sun describes an Orbit round an imaginary Point; nor to hear that t describes not its Orbit round S , but that another Letter besides t describes this Orbit; as to hear it positively affirmed of the Earth, that it describes not an Orbit round the Sun.

All I have to say to these Things is, that it appears evidently that our Author in this neither proves any Phænomena of Nature to proceed from his Cause, nor accounts for any of those Phænomena from his Cause; but instead of that, makes Phænomena that do not appear, to fit his Cause; because it will not fit those Phænomena that do appear, which for that Reason he lays aside. And in my Opinion this Management is so far from strengthening his Hypothesis, that it rather weakens it: For to me it seems the liveliest Proof that can be of the Absurdity of our Author's Cause, when we see him obliged to new-model Nature, to make it agree with

with his Cause, because his Cause will not agree with Nature.

Our other Author *Dr. Gregory* does not cover so well from View this Difficulty, which they are put to in managing their Subject: For he proposes and accounts for from his Cause, all those fictitious Phænomena almost without disguise in his 8th and 9th Sections, L. 1. And if any Man do but impartially consider how that Author is forced to distort the Simplicity of Nature, to fit it for his Cause, he will see the liveliest Representation imaginable of the hard Necessity which Men are put under, (by being obliged to be consistent with themselves,) when in Physicks they advance an Absurdity; for in Consequence of one that they have advanced, they are obliged to advance a whole Chain of Absurdities.

Mr. Newton, in his 13th Prop. tell us, that since he has discovered what Cause it is that produces the heavenly Motions, he may now demonstrate

monstrate *a priori*, what sort of Motions the heavenly Bodies perform, *viz.* demonstrate Mathematically what Motions his Cause must produce. So that the Physical Part of his Subject is now over, and these Demonstrations of the Effects of his Cause, are purely Mathematical, and relate no Ways to Physicks, if it be true that this Cause of the heavenly Motions, which he pretends to have discovered, is not the true one, which I think I have made appear: And so what follows in our Authors 3d Book does not concern my Subject. And yet I should also remark upon these Arguments, and show that they are rather worse than those I have remark'd upon; were it not that to lay open fairly and fully the Fallacies of those Arguments, would oblige me to lay open the other two Books also, with which they are connected; and this were to write a great Volume upon a Subject, which to me seems not worth so much Labour, as the writing

ing It would require ; and I believe most Readers would hardly think it worth Reading over. So that I shall content my self with telling my Reader in general what sort of Arguments those are, by which he proves from his Cause what the Motions of the Planets must be.

He knows from the best Observations, that Astronomers have hitherto been able to make, what are the real Motions of the Planets ; and those which he thus comes to know to be the real Motions of those Bodies, he (Right or Wrong) demonstrates that his Cause must necessarily produce.

I shall justify this Charge against our Author, without entering upon a nice Discussion of his Arguments, by an Instance of the most considerable of the Planetary Motions, about which, not only most of his Arguments, but most of the Study of all those who contemplate this Subject, are employ'd ; I mean the Motion of the Moon.

If

If that Planet move by the Attraction of the Earth and Sun, and by an Endeavour to run out in streight Lines, it's ~~plain~~^{plain} that when she is moving toward her Conjunction, the Attraction of the Sun must be in the same Direction with the Moon's Endeavour to run out in Tangents, and encrease that Part of the Cause of her Motion still, till she comes to her Conjunction; and there when this Endeavour is most encreased, the other Force by which she is attracted to the Earth, and kept from running out in Tangents, is Weakest: *viz.* The Attraction of the Earth—the Attraction of the Sun; the Sun's Attraction being just of a contrary Direction at that Time to the Attraction of the Earth.

But it's plain that a Body moved by two Forces together, must incline most to the Direction of that which is most powerful, and least to the Direction of that which is least powerful. So that the Moon's Orbit, when in her Conjunctions, must

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partake most of the Tangent Direction, or be least incurved toward the Earth, and so be most distant from it.

By the same Way of Reasoning, the Moon, when moving toward her Opposition, has her Endeavour of running out in Tangents diminish'd by the Attraction of the Sun till she arrive at her Opposition, and then is attracted to the Earth by the Attraction of the Earth—the Attraction of the Sun; and so by the foregoing Reasoning, her actual Motion must approach nearest to the Direction of that which is most prevalent in its Composure, *viz.* the Force by which she is attracted to the Earth; which being increased, and the other Force diminished, the Moon must then become nearest to the Earth.

It's very obvious that this must be the Figure of the Moon's Orbit, that our Author's Cause will produce; and if any Man please to go more nicely to work, and calculate how
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much farther the Moon must be from the Earth in her Conjunctions than at any other Time, and how much nearer in her Oppositions, upon our Author's Principles, he will find the Odds very considerable. But for my part, I design to meddle with no such Calculations, and think it sufficient to show in general, that in this most considerable Part of the Figure of the Moon's Orbit, our Author's Cause would demonstrate a Figure quite different from the real One which appears. And since he demonstrates the real One, it's plain his Demonstration cannot be sound; and that Observation has directed him in drawing the Conclusion of that Demonstration, rather than fair reasoning from his Principles.

This considerable Instance is sufficient to justify what I asserted of the rest of our Author's Demonstrations; and may be the easier taken for a full Proof of that Assertion, since that Part of them upon which

I have remark'd, appear to be fallacious; or if any Man is not satisfy'd with this, let him examine those Arguments himself, and he will find them to be such.

Both our Authors, when speaking of the Comets, speak less positively of the Nature and Cause of the Motions of those Bodies than of the Planets; and what they say is no more than to suppose them to be moved by their Universal Cause in Parabolas; whereas some of the best of Astronomers, from Observation, affirm them to move in streight Lines. But to do our Authors Justice, the Sides of those Parabolas, in which they will have them to move, differ very little from streight Lines; and I am inclin'd to believe that the Lines those Bodies do really describe, differ as much from streight Lines as those which our Authors suppose; though I can see no other Reason for thinking those Lines to be some of the Conick Sections, but that by this Means
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they are the more manageable and fit for our Authors Purposes.

But that which appears strange to me, is that those Comets moving toward the Sun in a Direction so near to a streight Line, as our Authors acknowledge, and at the same Time attracted by the Sun, do not fall upon it. Certainly the Direction of their Motion, according to all Authors, is not so far directed from the Sun, but that so strong an Attraction as the Sun, in our Authors Way of reckoning, must have at so small a Distance, would necessarily force them into a Direction streight to it; or if it could not force the Comet into a Line directed exactly to the Center of the Sun, yet sure the Body of the Sun is not small, but extends a great Way beyond that Point on all Sides; and it's strange the Comets do not fall foul of it in some Place or other.

Our Authors are so full of the Faney of their having demonstrated

that their Attraction can force a Body into a Curve, that they forget entirely the Natural Effect of Attraction, to make one Body move to another; they think a Body that is attracted can never fail to move in some of the Conick Sections, else surely they would have endeavoured to help their Cause in the critical Juncture of a Comet's Perihelium, where it stands so much in Need of their Assistance, to keep the Comet from falling foul of the Sun.

There remains yet another of our Author's Demonstrations, which I must not omit to consider, *viz.* his Demonstration that the Ebbing and Flowing of the Sea, is produced by the Attraction of the Sun and Moon; which is in his Prop. 24. L. 3.

This Demonstration consists of a long Narration of the Inequalities of the Tides in different Times, Places, &c. showing all along some Agreement betwixt the Alterations
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of the Tides, and the different Positions of the Sun and Moon, and especially of the Moon; still supposing the Tides and their Alterations to proceed from the Attraction of the Luminaries, attracting differently according to their Distance, or other Circumstances. And since there is nothing in this Proposition but Assertion, I shall in Answer to it assert, that I believe the Moon to have an Influence upon the Tide, but not the Sun; and that the only Reason for thinking the Sun to have such an Influence, as our Author asserts, is because the Temperature of the Air has an Influence upon the Ebbing and Flowing of the Sea, and the Sun or the Seasons of the Year have an Influence upon the Temperature of the Air. That it is this Difference in the Air which immediately affects the Sea, is well known to all who observe its Tides, which are as unconstant as the Weather, and rise very differently at times, when the Luminaries are the

same Way placed; neither is this to be accounted for always from high Winds at Sea, driving the Water toward the Shore, or from any such Cause.

But if it were true that the Tides did arise by some Influence of both Sun and Moon; What is that to our Author's Cause, unless he can show that the Attraction of those Luminaries, is that Influence by which this Effect is, or at least may be produced; which he supposes only and endeavours not to prove? I shall however, for full Satisfaction in this Point, suppose all to be true that our Author asserts in this Proposition, for perswading People to believe the Ebbing and Flowing of the Sea, to be the Effect of the Attraction of the Sun and Moon, *viz.* that those Attractions can raise two Protuberances in the watry Part of our Globe, one under the Moon, and the other upon the opposite Side of the Globe, and so turn the whole Waters into the Figure of a Spheroid;

roid; and that the Sun and Moon can by their Attractions vary the Shape of this Spheroid, as our Author will have it, by their different Positions. And all this being supposed, I shall demonstrate that the Eb-
bing and Flowing of the Sea, cannot possibly be the Effect of his Cause, since I shall in the following *Theorem* prove, that it must be different from what it appears, if produced by that Cause.

T H E O R E M IV.

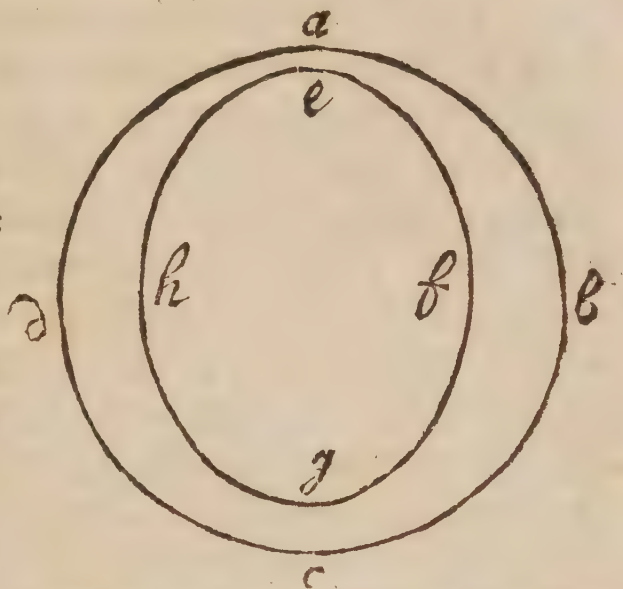
If the Moon draw the Waters of the Sea by her Attraction, so as to make two Protuberances of Water, the one under her, and the other diametrically opposite to that, or turn the whole Waters to the Shape of a Spheroid; and if these Protuberances be varied by her different Situation, or by the Attraction of any other Body acting upon the Waters also; yet Ceteris Paribus, that Protuberance of the Water which is
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under.

under the Moon, will be considerably higher in Respect of the Dry-Land, than the Protuberance which is upon the opposite Hemisphere.

Let the Circle $abcd$ represent the dry Land, and the Spheroid $efgh$ the Waters brought into that Figure by the Moon's Attraction: Suppose the Moon to be above the Protuberance of the Waters at e . Though g be also supposed to be a Protuberance, yet the Waters at g are press'd to the Earth's Center with the strongest Attraction, *viz.* by the Attraction of the Earth + the Attraction of the Moon; whereas the Waters at e are press'd to the Earth's Center by the least Attraction, *viz.* the Attraction of the Earth—the Attraction of the Moon, and so gravitate less than the Waters at g . The Waters also at f and h are drawn toward e , and not toward g ; beside the Waters at g being most press'd by Attraction, will run toward those low Places f and

and *b*, whereas the Waters at *e* will not, both because they are least pressed,

and because it is toward that the Waters



come from *f* and *h*; so that the Protuberance at *e*, or rather the whole Spheroid *efgh*, however otherways it be attracted, yet *Ceteris Paribus*, it must come nearer to the Point *a*, in the immoveable Circle *abcd*, than to the Point *c*; so that the Tide at *e*, which is under the Moon, (since the Moon's Attraction is most considerable) must rise higher in respect of the Land, than the Tide at *g*, which is upon the opposite Hemisphere, contrary to Appearance. Q. E. D.

I have now remark'd upon all that can be call'd Natural Philosophy, in *Mr. Newton's Principia Philosophiæ Naturalis Mathematica*; and upon the Arguments by which he and *Dr. Gregory*, the Chief of his Followers, support that Philosophy. And now I think it appears that their Mathematical Method, which was designed for the Safe-guard of that Philosophy, has proved quite otherways, and given me several Handles to disprove it with greater Certainty, (I mean Mathematical) than I could otherways have done. I think it appears also how unfit the Mathematical Method is for proving the dark Points of Natural Philosophy. Mathematical Demonstrations, when built upon the sure Foundation of Mathematical Principles, are like Houses of great Weight and Solidity, which are built upon a rocky Foundation, and are not easily overthrown; whereas he who builds the Superstructure of a Mathematical Demonstration upon

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on the weak Foundation of the Uncertainties in Natural Philosophy, does the same Thing as he who builds a great strong House upon the Sand. And the Arguments by which Mr. *Newton* supports his Philosophy, being of that Nature, could never have stood their Ground in the World, for the smallest Time, had it not been for that almost impenetrable Cloud of Obscurity, with which they were defended from all Attacks.

Mr. *Newton* himself tells us almost plainly in his Introduction to his 3d Book, that he designed thus to defend his Philosophy from the Attack of Disputants.* He says:

* *In libris precedentibus principia Philosophiæ, tradidi non tamen Philosophica sed Mathematica tantum &c. de Mundi Siftemate composueram librum tertium methodo populari, ut a pluribus legeretur, sed quibus principia posita satis intellecta non fuerint, ii vim consequentiarum minime percipient, neque præjudicia deponent quibus a multis retro annis insueverint; & propterea ne res in Disputationes trabatur summam libri illius transtuli in propositiones more Mathematico, ut ab iis solis legantur, qui principia prius evolverint &c.* thar

that his Philosophy being very inconsistent with Mens Ways of thinking, lest they should call it in Question, he had not propos'd it in the common Method; but put his 3d Book, which contains his Philosophy, in such a Method, that no Man should be able to understand it, without first understanding the two former Books that were Mathematical; and consequently could not impugn it, till they had first discusst those two Books. And the Difficulty there is in understanding, and much more in impugning those two Books, with which our Author thus guards his Philosophy, is very well known to the Learned World. By this Management, Mr. *Newton* put almost every Body beyond a Possibility of disputing his Philosophy; and the World have hitherto received this Philosophy, as they did of Old the Dictates of their Magi, or the Responses of their Oracles, without knowing the Meaning of what was imposed upon them,

them, or the Reason of what was said to them; which if they had done, those Dictates and Responses were generally such, as they would have despised. And I am perswaded had Mr. *Newton's* Philosophy been proposed in such a manner as to have been generally understood, it would have had the same Fate; and that the Reason of its being treated with so much Respect, was the same with that which made the *Heathens* honour so much those pitiful Equivocations of their Priests.

Since I have removed those Out-works, by which that Philosophy has hitherto been rendered inaccessible, I shall make bold with it, and propose it barely without any Disguise to the Eyes of the World, who, when they behold it in that manner, will (I am perswaded) have as slender an Opinion of it, as of any of the most exploded Schemes of the ancient Philosophers.

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Mr. *Newton* tells us, that * every the least possible Particle of Matter, or Body, attracts all Bodies at † all Distances; that the Being, whatever it is, that performs Attraction, or pushes Bodies toward each other, proceeds from those Bodies to which it belongs, and penetrates the whole Substance of those Bodies upon which it acts. Dr. *Gregory* tells us, †† that the Virtue, as he calls it, which performs Attraction, is like light Heat, &c. spread from a Center every Way through the surrounding Space equally; so that when spread through a larger Space, it is less in any part of that Space, because more dilated (*Diffusa* & *Sparsa* as he expresses it,) and when spread through a lesser Space, there is more of it in an equal Part of that Space, because there it is more pent up, (*Constipata*) and that the Quan-

* *Prop.* 6, 7 and 8. *L.* 3.

† *Page* ult.

†† *Prop.* 48. *L.* 1.

tity of this Virtue that is contained in any Part of a greater Space, is to the Quantity of it that is contained in an equal Part of a lesser Space, as the Spaces.

From these Accounts, I think, it were unjust to suppose that those Authors design to say, that Attraction is the immediate Action of those Bodies that are said to attract; for it is not to be thought that they could be guilty of Absurdities so gross as are included in such an Assertion, *viz.* to say that Bodies act immediately or by themselves, without the Intervention of any other Being, in a Place where they are not; that they thus act in many Places at the same time; that they proceed from themselves; that they penetrate each other; that the least Particle of Matter is extended as far as the Limits of the Universe, &c. It were, I say, the highest Injustice done to our Authors, to suppose that they mean to assert Bodies themselves to be the immediate Agents

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in performing their Attraction; since of that which is the immediate Agent, they assert what I have mention'd. So that whatever it is that performs Attraction, it must be something different from the attracting Body; and, since *agere supponit esse*, it must be a real Being.

Let us then consider what is said of this Being, which is the Instrument of Attraction. It proceeds from the smallest possible Particle of Matter equally all around, and extends as far as the Limits (if any be) of the Universe; so that to every Particle of Matter there belongs a Sphere of this Being as big as the Space or Extent of the Universe. The Quantity of this Being that is pent up in any part of those Spheres near their Center, is to the Quantity of it which is in an equal Part near the Surface, in a Duplicate, or rather Triplicate Proportion of the Distances of those Places from the Center of the Sphere; and yet since this Particle attracts every

every other Particle in Nature, there must not be the least Pore in this Sphere, even near its Surface, where the smallest Particle of Matter could be free of its Influence; nay, this Being must fill even the most distant Spaces so perfectly, as to penetrate the whole Substance of those Bodies which occupy any of it, tho' but equally spread.

Since every the least Particle of Matter must have belonging to it, such a Sphere as I have described, it's plain, that every one of those Spheres must penetrate each other, as well as they do Bodies; and if Matter be divisible *in infinitum*, there must be an infinite Number of such Spheres; or if the Doctrine of Atoms be true, yet the Number of those Spheres will be sufficiently great.

This extravagant Number of Spheres, of so enormous Bulk, and made up of a Being of such a strange Nature, is that by which, according to the *Newtonian* Philosophers, some

some of the most considerable Phænomena of Nature are performed. And who would think (when he hears with what Contempt those Philosophers treat good old *Aristotle*, for attributing the Secrets of Nature, which he could not discover, to occult Qualities) that those mighty Philosophers themselves had recourse to such an occult Cause as this; or who would believe, that they who receive nothing in Philosophy but what is proved by Experiment and Demonstration, who reject with Disdain the Causes conjectured by their Predecessors, *viz.* Spirits, or Second-rate Divinities, Qualities, Principles, and such like, were themselves framing Chimera's for producing the same Effects, of a much more stupendous Nature, than any one of the Fictions of their Predecessors? Certainly no Cause that ever was assigned by any Set of Philosophers, for the Production of any Effect, was ever so ridiculous as those Spheres; and if they had been.

been proposed to the World in that same plain undisguised manner that other Philosophers have proposed their Conjectures, they would never have been received; and nothing but the shew of Mathematical Demonstration, together with the Obscurity with which this Scheme of Physicks was veil'd, could have prevented its being hiss'd off the Stage at its first Appearance in the World.

After having considered this Philosophy, as it must have appeared to the Imagination at first View, if it had been proposed in the common simple Method, in which Natural Philosophy has always been proposed; let us next see how it must have appear'd to the Understanding, upon Reflection.

That Reflection upon this Philosophy which to me seems readiest and most natural, is its Repugnance to the Simplicity of Nature, and the Wisdom of its great Author. For nothing appears more clearly in
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this Philosophy, than the vast Multitude and confused Complication of Causes supposed, for producing a few plain Effects; and nothing appears more clearly in Nature, than the Multiplicity of great and stupendous Effects, proceeding from few and plain Causes. And it is this very Appearance in Nature, wherein we trace the clearest Footsteps, not only of Council and Design, but of infinite Wisdom in the Author of Nature: For to do what one designs by the shortest, straightest, and simplest Means, is the sure Mark of Wisdom; whereas to do a great deal more than is needful for bringing about one's Designs, is a certain Mark of Folly and Ignorance. And if so, how unlike is it to the Simplicity of Nature, and the Wisdom of its Author, to have so great a number of such immense Spheres, made up of a Being of so extraordinary a Nature, for causing Seventeen Spherical Bodies to roll in uniform Orbits, and the Parts of
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those Bodies to keep together ; which is all that these Spheres are contrived for by the *Newtonian* Philosophers ? Certainly this is turning Nature upside down, and placing in it Marks of as great Folly and Ignorance in its Author, as there really are in Nature Marks of his Wisdom and Discretion : For here is a stupendous multiplicity of Causes made use of to produce a few plain and simple Effects, instead of a multitude of Effects proceeding from a few plain and simple Causes ; which is always observed to be the Order of Nature.

The Reflection upon this Philosophy that seems next to present it self to our Mind, is the Inconsistence of the Nature of that Being, of which those prodigious Spheres (the Instruments of Attraction) are made up, according to the Accounts we have of the Nature of that Being from our Authors. * They

* *In immensas Distantias undique extenditur.*
pag. ult. Prin.

tell us, that this Being exists in a Place separate from that Body to which it belongs, and there acts so that it must be a Substance. † They tell us also, that it is dilated in a greater, and compress'd and closely pent up in a lesser Space ; and that its Quantity in any Parts of those Spaces, is as the Spaces. And from this relation betwixt the Quantity of this Instrument of Attraction, and the Quantity of the Space in which it is contained, it appears to be something that is extended ; and an extended Substance is Body or Matter. So that this Account we have of the Nature of the Instrument of Attraction, is equivalent to an Assertion that it is composed of Body ; and from hence a whole Cluster of Absurdities follow, *viz.* this Instrument of Attraction, which extends to and fills all Places, must so fill all Space, as to leave no

† Prop. 48. l. 1. *Greg. Astro.*

Void, or no Space that is not filled with Body, though our Philosophers themselves be the greatest Asserters of a Void of all other Sects, since their Philosophy requires the whole Planetary Regions to be almost or rather altogether void.

From this it also follows, that Body penetrates Body; for we are told that this Instrument of Attraction penetrates Bodies: nay, it here follows, that every Body is penetrated by as many different Bodies at once, as there are Particles of Matter in the Universe, since every Particle of Matter has its Instrument of Attraction.

But the greatest Absurdity that arises from this Reflection is, that every Particle of those Spheres that are the Instruments of Attraction, must also attract; because according to our Philosophers all Bodies attract; and consequently every Particle of those Spheres must have a whole Sphere belonging to it, to

be the Instrument of its Attraction; and so *in infinitum*.

Though the showing that these Absurdities follow from the *Newtonian* Philosophy, be as good Proof of its Falshood, as any that can be drawn from the Principles of Natural Philosophy; yet I have not showed those Absurdities, as if I imagined my so doing to be a Proof of the Falshood of that Philosophy, of superior or so much as of equal Evidence and Certainty with those Demonstrations, by which I have already Mathematically demonstrated this Philosophy to be false; or as if I thought that those Demonstrations stood in Need of any additional Proof to strengthen them. My Design in giving this short View of the Absurdities that may be drawn from the *Newtonian* Philosophy by Physical Reasoning, was only to show the Absurdities of that Philosophy, to those who are not so well acquainted with Mathematicks, as to gather
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ther them from my Mathematical Demonstrations, where they appear to the greatest Advantage.

I HAVE now (I think) fully disproved the *Newtonian* Philosophy, to the Satisfaction of every judicious Reader; and after all, in so doing, I have only show'd that Sect of Philosophers to be mistaken in a Matter which has deceived all other Sects of Philosophers, as well as them; and that their Master has not discovered the Thing that never Man was able to find out. I have only made appear that they have not hit upon the true Cause of the Motions of the heavenly Bodies, and so set this Philosophy upon a Level with all others. I shall next remark upon some Faults peculiar to this Philosophy, that it may be judged of in Respect of other Schemes of Philosophy, to which this is so generally preferred.

It is observable of the *Newtonian* Philosophy, that it is advanced with

a greater Shew of Certainty than any other; and that what it proposes to our Belief, is not proposed as most Parts of Natural Philosophy ought to be, *viz.* as probable, but as absolutely certain and mathematically demonstrated. And since this Philosophy is as false as any other, it's plain that it is the more to be found Fault with, by how much the greater Shew of Certainty it carries. For every Body knows that he who advances a Falshood, the more positive he is, and the greater Assurance he shows in Advancing it, the more he Errs: And that any Man who takes a Proof, which has no manner of Strength in it, for absolute Demonstration, is more grossly deceived by that Proof, and is a worse Judge of Reasoning, than if he had taken that Proof for probable Reasoning only. And if this be true, as it certainly is, the *Newtonian* Philosophers have erred more grossly than any other Sect, and have judged more
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amiss of the Reasons upon which they grounded their Belief.

But let us lay aside the Manner in which this Philosophy is proposed, and consider the Philosophy it self.

It contains no more, but that Part of Physicks which concerns the System of the Universe; which it's true, is the greatest, the noblest and most difficult Part of Natural Philosophy.

This Part of Philosophy has been very variously and absurdly handled by Philosophers; but in these latter Ages, the more ridiculous Fictions with which it formerly abounded, were laid aside; and the Motions of the heavenly Bodies, by the Invention of proper Instruments, came to be better discovered; and the general Opinion of Philosophers has been, that the heavenly Bodies moved by the Force of a Fluid, driving them in their Orbits. And when they pursued this Study a little farther, and begun to en-

quire into the particular Nature of that Fluid, the Manner in which it moved, when impressing upon the Stars that Force by which they were kept in their Orbits, and the Cause that put it in such a Motion, they went beyond their Depth, and run into many extravagant Opinions, which were inconsistent with Nature.

Of those Opinions, the most considerable was that of *Cartes* and others, who affirmed that the Fluid by which the Planets were forced into Orbits, was made up of a Substance of equal Density with that Substance of which the Planets consisted; that the Manner of this Fluid's Motion was in Vortexes; and that the Cause by which it was moved in that Manner, was some certain Power bestowed upon the primitive constituent Particles of Matter, of turning upon their Axis.

This was the State of Philosophy, and these were the fashionable Opinions that Men generally entertained

tertain'd of the Causes of the heavenly Motions, when the *Newtonian* Philosophy made its first Appearance; and as the Author of that Philosophy and others very well observe, these Opinions were prest with many and great Difficulties. The Planets did not appear to move in the same Manner, as those Vortexes by the Laws of their Motions must have forced them to do. It appeared also incredible that the Matter which compos'd those Vortexes, was of like Density with the Bodies of the Planets. And the turning of the primitive Particles of Matter upon their Axis, and such other Motions as were ascribed to them, look'd very like a Fiction. These were the Sum of the Difficulties by which this Philosophy was prest. And it was for these Defects that Mr. *Newton* rejected this Philosophy, and * as himself

* *Hypothesis vorticum cum Phenominis Astronomicis, omnino pugnat & non tam ad explican-*

tells us, he proposes a new Scheme of his own to clear this Part of Natural Philosophy of the Difficulties that attended the *Cartesian* Hypothesis.

Let us then see how far our Author's Scheme improves that Part of Natural Philosophy, and clears it of the Difficulties with which the *Cartesian* Scheme was prest: Supposing our Author's Philosophy had been supported by as good Arguments as it appeared to be.

The Sum of the *Newtonian* Philosophy, as far as it was supported by any Arguments, consisted in the Discovery of the Quantity or Direction of the Force, by which the Planets were kept in their Orbits, abstracting from that Being whose Force this was; and the other Part

dos, quam ad perturbandos motus celestes conducit; quomodo vero motus isti in Spatijs liberis absque vorticibus peraguntur intelligi potest ex Libro primo, & in Mundi Systemate plenius docetur, P. 355. Prin.

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of that Philosophy, which tells us that the Body, to which this Force is directed, impresses that Force upon the Planets, is supposed only, and not the least Shew of Argument offer'd to prove it, as I have shewed before. So that no Man could think better of this Philosophy, than that the Abstract Quantity of Force, by which the Planets were actuated, was Matter of Demonstration and Certainty ; and that the Assertion or Supposition, that this Force proceeded from the Action of that Body to which the Force was directed, was Matter of Opinion or Hypothesis only ; no Man could think any better of this Philosophy, except they took its Author's bare Word for Proof.

It is hardly to be supposed that Men of Learning or good Sense could ever have had so good an Opinion as this of the *Newtonian* Philosophy, or have thought that the Quantity or Direction of the Force by which the Planets were actuated,

could be matter of Demonstration : For they who knew any thing of resolving Motions, could not but know this in general, that any given Motion whatever may be resolved into an infinite Number of different Forces ; and that therefore it might be Mathematically demonstrated, that no Demonstration could ever be brought to prove, of any Motion whatever, that it must necessarily be produced by any certain Force. And even those who did not understand any thing of resolving Motions, could not but know that the Current of a River (for instance) might describe an Arch of some Circle ; and if a Log of Wood were thrown into this Current, it would force the Wood to describe round the Center of that Circle Areas proportionable to the Times : and yet it is plain, that the Current presses not upon that Log of Wood with a Force directed toward the Center of that Circle. And from this Similitude might gather, that a Force directed

rected to a Center, could never be the only Force that could make the Planets describe round that Center Areas proportionable to the Times.

It may indeed be supposed that Men of Learning and good Sense were so far deceived by our Author's Arguments, as to believe that a Centripetal Force might produce the Motions of the Planets, or that these Motions might be accounted for from a Force of that Direction; but it cannot never be thought that any, who considered the Matter, could think that no other Force but that could produce this Effect: Nay, I am convinced that it is true in Fact, that the learned World generally understood no more to be proved by our Author's Arguments, but the fitness of this Force for producing the Effect; and never questioned but a Force of that Direction and Quantity, (whatever this Direction and Quantity was) which a Fluid equidense with the Bodies of the Planets moving in a Vortex of the Shape

Shape of their Orbits could impress upon them, was a Force at least as fit for carrying them in their Orbits, as a Centripetal Force could be. So that if the abstract Quantity of Force had been all the matter in Question, the *Newtonian* Philosophy could have pretended to be no more than equal with the *Cartesian*.

The *Cartesian* Philosophy, or the Hypothesis of Vortexes, (says our Author) is press'd by many Difficulties: But what Difficulties? Sure it was never by any Man objected against this Philosophy, that the Abstract Quantity of Force supposed, was not sufficient for producing the Motion that appears, *viz.* That the Current of a Fluid equidense with the Planets, could not carry them along with it, or impress such a Force upon them, as was sufficient to make them describe such Figures as the Figure of the Vortex. The Difficulties with which this Hypothesis was press'd, only arose from what *Cartes* said of the Nature of
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that Fluid which composed these Vortexes, and the Cause and Manner of its being brought and kept in that vortical Motion. If *Cartes* had said no more in Philosophy, than barely to have condescended upon the abstract Quantity of the Force of his Vortexes, as our Authors do, he would have been clear of all such Objections. And what is it that defends the *Newtonian* Philosophy from Objections of the same nature, but that they advance less, and do not tell us what is the Nature of that Being which impresses upon the Planets their Centripetal Force ; and what is the Cause that makes it act upon them, nor in what manner it acts. So that their Philosophy is only preferable in advancing little : and if this be a Perfection, he that meddles not at all with Philosophy, is the best Philosopher.

But after all the Caution the *Newtonian* Philosophers use in this matter, they say as much of that
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which, according to them, is the thing that impresses upon the Planets their Centripetal Force, as shows their Hypothesis to be in that respect press'd with much greater Difficulties than any that were ever urged by any Man against the *Cartesian* Philosophy; as sufficiently appears from the slight View I have given of the Absurdities that may be drawn from their Hypothesis by physical Reasoning; which all follow from the Nature of that Being, which, according to our Philosophers, impresses upon Bodies their Centripetal Force, and the manner of its performing that Operation; the very same Sources from whence those Difficulties, by which the *Cartesian* Philosophy is press'd, does arise.

It appears then that the *Newtonian* Scheme did in no respect amend the Faults of the *Cartesian* Philosophy; but in all those very same Circumstances, in which the *Cartesian* Philosophy failed, was much more de-

defective than it, even if the *Newtonian* Philosophy had been as good as it can be supposed to have appeared to any Man of Learning or good Sense. But let us suppose the World to have been intirely deluded with the Arguments by which that Philosophy was supported, and to have thought every thing that was in the least like the Shape of a Demonstration to have been really such, and that those Demonstrations concluded what the Propositions asserted in the strictest Sense of the Words; still all they could have believed from those Demonstrations was, that no other Force but a Centripetal could possibly produce the Motions of the Planets: But still they had no reason to believe it to be certain, that this Centripetal Force was impress'd upon the Planets by the Action of that Body which was placed in that Center. For this is what no Proposition asserts, and for which nothing like Proof of any kind is offered. And
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it appears evidently to any Man that will but read over this Philosophy, that this is only supposed; and if this be no more than Hypothesis, why not inquire into the Difficulties by which such an Hypothesis is press'd? Which if any Man had done, could any thing be more obvious than those Difficulties? Such as the Difficulty of supposing a Body to act immediately in a Place where it did not so much as exist; or if that was not supposed to be the immediate Action of that Body, then was it as difficult to find a proper Instrument for conveying such an Action.

All the Advantage that could arise to the *Newtonian* Philosophy, from taking for certain all that was supported by any thing like Demonstration, was only that then indeed the Hypothesis of Vortexes must be laid aside, since nothing but a Centripetal Force would do the Business. But why might not this Centripetal Force still have proceeded from the
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Action of a Fluid? The probabilities of a Fluid being the Mover of the Planets, which forced so many Philosophers into that Opinion, still remained in full Force: and it was but changing the Hypothesis, and instead of supposing the Fluid, by which the Planets were moved, to run round in a Vortex, it might have been supposed to run to a Center. It's true indeed, the Theorem by which it was demonstrated, that nothing but a Centripetal Force could cause the Planets to describe such Orbits as they do, would in that case have been a very considerable Improvement to that part of Natural Philosophy. But still the Author of this Theorem could not be supposed, by his Invention, to have acquired a right of employing any thing he pleased to put in execution that Centripetal Force which he had discovered to be necessary. So that he ought not in such an arbitrary manner to have affirmed, that his Centripetal Force was produced
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by the Action of that Body to which it was directed. His Discovery, at best, was but a Discovery of the abstract Quantity of Force, by which the Planets were moved ; and not of the Mover, whose Force this was. And he ought not to have affirmed any thing to be this Mover, without having some other ground for so doing, than his having discover'd the Quantity of Force impress'd upon the Planets. But if he had asserted no more than what he seem'd to have discovered, his Invention would only have appeared to be an Improvement of other Mens Opinions ; whereas by managing the Matter as he did, he made much more of his Discovery, and pass'd it upon the World for a whole Scheme of the System of the Universe, perfectly new, and modelled by a Cause which he only had found out, and which was utterly unknown to former Ages.

It was a very singular Piece of Management in our Author, to make
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So much of so little, or rather of nothing at all; and to get the World so generally to believe an arbitrary Assertion, supported by no Proof, nay, not so much as by the shew of any Argument; for no Reason, but because he had discover'd, or rather seemed only to discover, something quite different from that Assertion; especially, since as I have already made appear, this Assertion is press'd by as great and as obvious Absurdities and Inconsistencies, as it is possible for any thing that is asserted in Natural Philosophy to be.

I have hitherto compared this Philosophy, and its Method, with other Schemes of Physicks and their Methods, and particularly, with that which was by the World generally received at the time when this Philosophy was first propos'd, and was generally rejected after its Appearance; and have made appear, that in every respect in which that Scheme of Physicks was press'd with Difficulties, our Scheme was press'd with

with much greater ones of the same kind: And that tho' our Scheme had been as good as it can be supposed to have appeared to any Man of Learning or good Sense, yet it could appear in nothing perferable to that Scheme which was thtrown off to make way for it. All which makes the Management by which this Scheme was recommended to the World, appear to be very extraordinary.

I shall now enquire into the Reasonableness of a Postulate, upon which that Philosophy depends, *viz.* that the Planets are free of Resistance.

I call this a Postulate, tho' both Mr. *Newton* and Dr. *Gregory* pretend to prove it, because the Demonstration of the former of those Authors depends upon a Postulate equivalent to it, *viz.* that the Fluid, which lies betwixt us and the Planets, rarifies in the same continued Chain of Proportion that begins in the lower parts of our Atmosphere; by which
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he computes, as I said before, that the Density of that Fluid, at the Distance of one of the Earth's Semidiameters from the Surface, is to the Density of it upon the Surface, as a Globe whose Diameter is equal to the Diameter of *Saturn's* Orbit is to a Globe of an Inch Diameter; and so this Fluid continues to rarify in that Proportion, till it come to the planetary Regions. This Postulate, upon which Mr. *Newton's* Demonstration of the Absence of Resistance depends, is certainly equivalent to his postulating what he proves; nay, much more ridiculous.

Dr. *Gregory's* Proof of the Absence of Resistance, is no more than a Proof that their Scheme cannot subsist without it: And that Author tells us in plain Terms *, that this Absence

* In Propositione ubi determinatur lex vis Centripetæ qua urgetur Corpus quod revolvitur in perimetro Elipsis aut alterius Sectionis Coni, cujus focorum

sence of Resistance is all along supposed in those Propositions where their Centripetal Force is reconciled with the Phænomena of the heavenly Motions; nay, the making appear that this is supposed, and that without that Supposition their Cause would not be reconciled with its pretended Effects, is all the Demonstration he brings to prove this Absence of Resistance.

But that which makes it most clearly appear that this is a Postulate, is, its being supposed in Mr. *Newton's* first Proposition, *L. 1.* and Dr. *Gregory's* Eleventh Proposition, *L. 1.* upon which their whole System depends. For in those Propositions it is asserted of the moving Body, that if it move a certain Space in a certain Time, it will by the Nature of Bodies in Motion move a Space e-

focorum alter est Centrum ad quod vis tendit; supposuimus motum utrumq; ex quibus Componitur motus in Curva Elliptica Parabolica vel Hyperbolica, omnino liberum nec illi quidquam obstare aut resistere, &c. L. 1. Prop. 44.

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qual to that Space in equal Time, if nothing hinder it; and upon this these Propositions depend, as will appear by looking to those Propositions themselves, or to those Propositions as I have repeated them in the Beginning of my Remarks. So that all our Scheme is evidently built upon this Postulate, that nothing resists the Planets in their Motions. But if any Body were in those Regions through which the Planets move, they must force this Body out of their Way, and it must return that Force by its Reaction, and this Reaction is Resistance; so that if the Planets are not resisted, there must either be no Body at all in the Planetary Regions, and so they are absolute Voids, or at least ther must be no more Body there than Mr. *Newton's* Computation of the Density of the Fluid he allows to be there, will admit; which is much the same Thing as no Body at all.

I admire that our Authors should have postulated of the World to believe that not to be, which not only all Philosophers, but (I may rather say) all Mankind believed to be. Certainly no Man ever believed the Planetary Regions to be Voids, nor will either Sense or Reason allow any Man to believe it. But still if this Postulate had been less improbable, and it had been no more than the general Opinion of Mankind, that the Planetary Regions were not void; the Respect due to such an universal Sentiment in which Men agreed, required some Reasons to be given to the contrary; and it was an extraordinary Piece of Assurance, thus to postulate of the World, that they would renounce so general an Opinion: As much as if it had been said in plain Language, Gentlemen, renounce that Opinion you have always had, and believe the contrary, without any Reason for so doing.

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This is certainly the most extravagant Postulate that ever was heard of; nay, it is not only so with respect to the universal Belief of the contrary, but also with respect to the Evidence and Certainty with which the contrary appears, and may be demonstrated to be true: For what Point in Natural Philosophy appears with more Evidence, than that the Planetary Regions are not Voids? What Proof does Natural Philosophy afford that is more strong, or rather what Proof will the Nature of the Subject admit of, that is more evident than the Proof that the Planetary Regions are filled with some sort of Body?

That sort which most certainly appears to fill the Planetary Regions is Light, which I shall not here take up Time in proving to be a Body, because that is owned by our Philosophers; neither shall I endeavour to prove any thing particular of the Nature of that Body, or endeavour

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deavour to shew it to be something different from what the *Newtonian* Philosophers believe it to be, tho' I think it so, because that relates not to the Point in Hand: For whether it be such a Body as I take it to be, or such as those Philosophers believe it to be, is all one, as far as concerns the Point in Question. So that I shall suppose it to be just such a Fluid as they do, sent from the Body of the Sun in streight Lines, through all the Planetary Regions successively every Instant of Time, or by a continu'd Emission of that Fluid from the Body of the Sun.

If then Light be such a Body, is not the Planetary Regions filled with this Body according to our Philosophers themselves? And how can they for serving a Turn, at another Time assert, that the Planetary Regions are Voids? Or at least, what is equivalent to this Assertion, that the Planets move thro' these Regions free from the Action or Reaction of any thing but Attraction only? If

If to put aside this Difficulty, they diminish extravagantly the Quantity of Matter contained in the Fluid of Light; as Mr. *Newton* does the Quantity of that other Fluid, (which he acknowledges to lie betwixt our Earth and the Planets; and after supposing the Quantity of this Fluid to be such as will suit their Occasions, then tell us that the Force of the Action of a Fluid being as its Quantity, the Force of the Action of this Fluid is almost nothing; it will not be very easy to bring full Proof to the contrary. And this Shift is to be expected from our Philosophers, since they have such a singular Art in framing Hypotheses to fit their Purpose, and take Liberty to suppose what they please, and to turn out of the System of Nature any thing that is repugnant to their Scheme, though appearing with the fullest Evidence imaginable. But if they take that Method in this Case, and assume such an unreasonable

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Hypothesis without any Probability, merely because the Inconsistence of their Scheme with Nature forces them to do so, this will be a Proof of the Falsity of both their Scheme and Hypothesis ; than which it is hard to find better Proof in Natural Philosophy. For they who indulge themselves a full Liberty of framing as many Arbitrary Hypotheses as they have Occasion for, may stand out against all the Arguments that can be brought against them ; for if in any thing they be streighten'd, it's but supposing something to be such as will serve to answer the Difficulty, and their Streight is over. And they who can play this Game with a little Art, are Proof against all the Demonstrations that can be brought, and cannot be convicted of their Errors so as to be forced to own them to be such.

If our Philosophers had managed all along this Way, I should have had much harder Work with them
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than I have had ; and should never have been able by full and positive Demonstration to disprove their Philosophy : For this I have only been able to do, because their Philosophy consists chiefly in Assertions of Abstract Quantities, which brings it within the reach of Mathematical Demonstration ; whereas this which is a Point of a quite different Nature, is not to be disproved with equal Evidence.

I shall however show, with as great Evidence as the Nature of the Subject will allow, and consequently as great as is to be expected, that the Quantity of Matter contained in the Fluid of Light is not so small, as that the Action of that Fluid upon the Planets should for that reason be thought insensible ; or rather, that in Fact this Fluid acts upon them with a Force that cannot but have some sensible Effect upon their Motions. For making of this appear,

Let us suppose the Planets to be covered with Atmospheres, or if that be not allowed, let us take for in-

stance our Earth, which we know to be so. These Atmospheres are parts of the Planets, since they turn with them upon their Axis, and accompany them in their Motions ; in short, those Atmospheres are joined to the Planets by the same Cement of Gravity (whatever the Cause of Gravity be) which keeps together all their other Parts. This appears very clearly to be true in the case of our Earth. And if those Atmospheres be thus join'd to the Bodies of the Planets, it's plain that any Force impress'd upon these Atmospheres must in effect be also impress'd upon the other Part with which they are connected.

It is very easy to judge of the Effect that any Force acting upon our Atmosphere must have upon the Globe, from the Effect it appears to have upon the Atmosphere, and from the Force that our Atmosphere can impress upon solid Bodies ; which appears in the Impression that Winds (which are nothing else but
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Currents in our Atmosphere) make upon Bodies ; or by computing the Density of our Atmosphere and Globe, and proportioning the Effect of any Force upon these two to their Densities. And since the Force of Wind even upon Bodies of great Density, appears to be considerable, and that the Difference of the Density of our Globe and Atmosphere is not extreamly great ; it's plain, that a Force which produces upon our Atmosphere any great Effect, must produce also upon our Globe much more than is consistent with that absolute Freedom in the Motions of the Planets, for which our Philosophers contend. So that the thing which comes now to be consider'd is, what Effect the Fluid of Light, the Sun-beams, or whatever else That may be called, which the Sun scatters continually through the whole planetary Regions, produces upon the Atmospheres of the Planets, or upon our Atmosphere in particular.

This Force is discoverable in that

Phænomenon which we call Rarefaction, or Tension of Air, which is effected by the Action of the Sun-beams, and cannot be performed without a Force driving the Air from that place which it naturally affects. The Force by which the Sun beams thus drive the Fluid of our Atmosphere, may be estimated from the Tension of Air it produces, and from the Force that is necessary to make such Tension; which appears from the Instruments by which an artificial Tension of Air is produced.

The Tension of Air that arises from the Heat of the Sun, appears very clearly to be produced by a Force, whereby the Sun-beams drive the Air before them in the *East* Winds, within the Tropicks; and the Effect of this Force, when communicated by our Atmosphere to the Solid, at least the Watry part of our Globe, which is almost Equidense with the Solid part, appears also very plainly in the constant and general Motion of the Sea, in the
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same Direction with those Winds. And they who have any Taste of Natural Philosophy, will, in this Appearance, evidently see that the Sun-beams, with which the planetary Regions are filled, impress upon the Planets continually a very considerable Force ; so that those Planets do not, as our Authors suppose, pass through these Spaces, absolutely free of any Force acting upon them.

But because every Reader cannot discover in this Phænomenon, which I have instanced, the Proof of what I assert, because they are not accustomed to those ways of Thinking that are necessary for their perceiving the full Evidencethat may be seen in that Appearance ; I shall instance another Phænomenon, in which it appears evidently even to the Senses, that the Sun-beams act with a considerable Force upon the Bodies that move through the planetary Regions.

Astronomers agree, that all Comets

mets turn their Tails always directly away from the Sun, whether moving to the Sun or from it, or whatever way their Situation in respect of it changes; and if so, they who have seen a Comet, have seen it acted upon by the Sun-beams, and they who never saw a Comet, have the universal Testimony of those who have seen it.

It is very easy to show, that the Force with which the Sun-beams act upon a Comet, is evident in this Appearance, by what our Philosophers themselves acknowledge. Sir *Isaac Newton* says *, that the Tails of the Comets are made up of the Exhalations drawn from the Body of the Star by the Heat of the Sun; and that these Exhalations near the Body of the Star, appear like Smoke arising from it; and when arising in great plenty, make the Body of the Star seem much more obscure, and appear with a fainter Light than o-

* *Prop. 41. L. 3. Prin.*

therways it would do. And if this be true, as it certainly is, that the Tail of a Comet is made up of the Smoke and Exhalations, which the Heat of the Sun draws from the Body of the Star, the Matter of which these Tails are composed before it was by the Heat of the Sun separated from the Body of the Star moved in the same Velocity and Direction as the Star, and must have continued so to do, if moving in a place were nothing acted upon or resisted it; and the Smoke and Flame arising from the Comets must be hindred from keeping close to the Comet, which by the Law of Motion they must have done by some Force, either by that Force which causes the Smoke and Flame proceeding from solid Bodies upon our Earth, to tend upwards, or move still directly away from the Earth, *viz.* the greater Gravity of our Atmosphere; and then this Appearance will prove that Fluid in which the Comets swim, to be heavier or more dense

dense than the Exhalations drawn from the Comet by the Heat of the Sun ; or else those Tails must be drove that way by the Force of the Sun-beams.

I believe our Philosophers will not readily allow, that the Cause which forces the Tails of the Comets to point from the Sun, is the superior Density of that Fluid in which those Comets swim ; because this were to allow that Fluid to be of equal Density with our Atmosphere, which it must be if that be the Cause ; since we cannot suppose the Smoke and Exhalations drawn from the Bodies of the Comets, to be of a Nature far different from the Smoke and Exhalations drawn from other Bodies, which does not rise in a Fluid less dense than our Atmosphere. This, I say, our Philosophers will not allow, because allowing the planetary Regions to be filled with a Fluid as dense as our Atmosphere, were giving up their Cause. And if they say, that the
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Tails of the Comets are drove by the Sun-beams, they own what I am proving.

For my part, I cannot see any other Cause from whence the Force by which the Exhalations drawn from the Bodies of the Comets are drove from the Sun can proceed, but those two which I have instanced. But it matters not much, whether our Philosophers allow any of those to be the Cause or not, since whatever Cause be assigned for the Production of this Appearance, yet still the Appearance it self shows that it is something in the planetary Regions that impresses upon Bodies moving through those Regions; such a Force as can upon Smoke produce a very powerful Effect: And this Force, whatever it is that has such an Effect upon the Smoke that arises from the Comets, cannot but have such an Effect also upon the Atmospheres of the Planets, since they are made up of a Substance very near of the same Density; nay, whe-

whether the Tails of the Comets be allowed to consist of such Exhalations or not, yet they appear to be parts of the Comets which are joined to them, and move along with them. And without entering into any nice Enquiry into the Nature of those Tails, even they who know nothing of Natural Philosophy, cannot but see from a Comet's turning its Tail always from the Sun, that the Fluid in which it is, impresses upon it a sensible Force ; as well as by seeing a Ship that lies at Anchor turn always her Stem to the Tide, or a Weather-Cock still turn his Head to the Wind, they may believe that the Current of Water beats upon the one, and the Wind upon the other. In short, a Man might as well see a Ship at Sea, with full Sails, bending from that Side upon which the Wind did beat, and as the Wind shifted or the Ship changed its Course, still leaning directly away from the Wind, and believe that the Wind impress'd upon

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on the Sails of that Ship no Force, or that those Sails communicated to the Hull no Force able to produce upon it any sensible Effect; as see a Comet turning its Tail still away from the Current of Light proceeding from the Sun, and believe the Sun-beams to impress upon that Tail no Force, or that the Tail communicated to the Body of the Star no Force that is sensible. The Atmospheres of the Planets, like the Sails of a Ship, are extended wider through the Regions in which the Planets move, than the Body of the Planet, and so are more obnoxious to the Impulse of that Ethereal Fluid, and must necessarily communicate to the Body of the Planet what Impulse they receive, either from the Sun-beams, or any other Fluid whatever that is in the planetary Regions. And tho' I might bring very good Arguments for proving other Fluids beside that of Light to be in these Regions; yet what I have proved of that only,

ly is sufficient; and he who will not by what I have already said be convinc'd that the Stars move not through the Planetary Regions at absolute Freedom, will never be convinc'd of any thing by Physical Reasoning.

I think it now appears how unreasonable it was for the *Newtonian* Philosophers to build their Philosophy upon an Hypothesis, that the Planets move through the Planetary Regions at absolute Freedom: Since that Hypothesis was not only inconsistent with the Opinions of all Philosophers, but in it self absurd and inconsistent with the Phænomena of Nature. So that not only the Method of the *Newtonian* Philosophy, and the Philosophy it self, but the Hypothesis upon which it is built, is worse than most Hypotheses upon which other Schemes depend, especially that to which ours succeeded.

I have hitherto pursued my Subject, so as to set it in the best
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Light I could, without considering whether what I happened to say might give Offense to any Person whatever. And upon Reflection, I find that the Prosecution of my Subject, and the Endeavour of setting it in the best Light, has drawn me to represent the famous Sir *Isaac Newton* as One that has not made so great Improvements in Philosophy as he is generally believ'd to have done; and consequently, some Readers may think, that I derogate from the Honour of that Great Man. For my part, I am quite of another Mind, and believe nothing to be true Honour, but what is built upon a solid Foundation, as *Cicero* describes it, *Constans Laus bonorum*; and consequently, that the Honour due to this great Man for his real Improvements of Learning, will remain unshaken to After-Ages, and is above the Reach of the Tongue or Pen of the Envious; and I should detest my self, if I could think that I were capable of the

impotent Endeavour of detracting from his deserved Praise. But if Sir *Isaac Newton* has in any thing been mistaken, and the World has been too fond of any of his Mistakes, and not distinguish'd those from his solid Inventions ; it derogates neither from the real Worth of that great Man, nor from his solid and lasting Reputation, but rather settles it on that Foundation upon which it must continue, to undeceive the World in these Matters: And beside this, Truth and the Improvement of Learning, Causes of so general Concern as not to be over-ballanced by private Considerations, require this to be done, and therefore the doing of it needs no Apology.

F I N I S.





G. Montague

